

The image shows the front cover of an old book. The cover is decorated with marbled paper featuring a pattern of brown, yellow, blue, and red veins. A central rectangular label with a decorative border contains the text "PHARMACY" and "J. CARSON." in gold lettering. The spine of the book is visible on the left, showing a dark, worn binding.

PHARMACY

J. CARSON.

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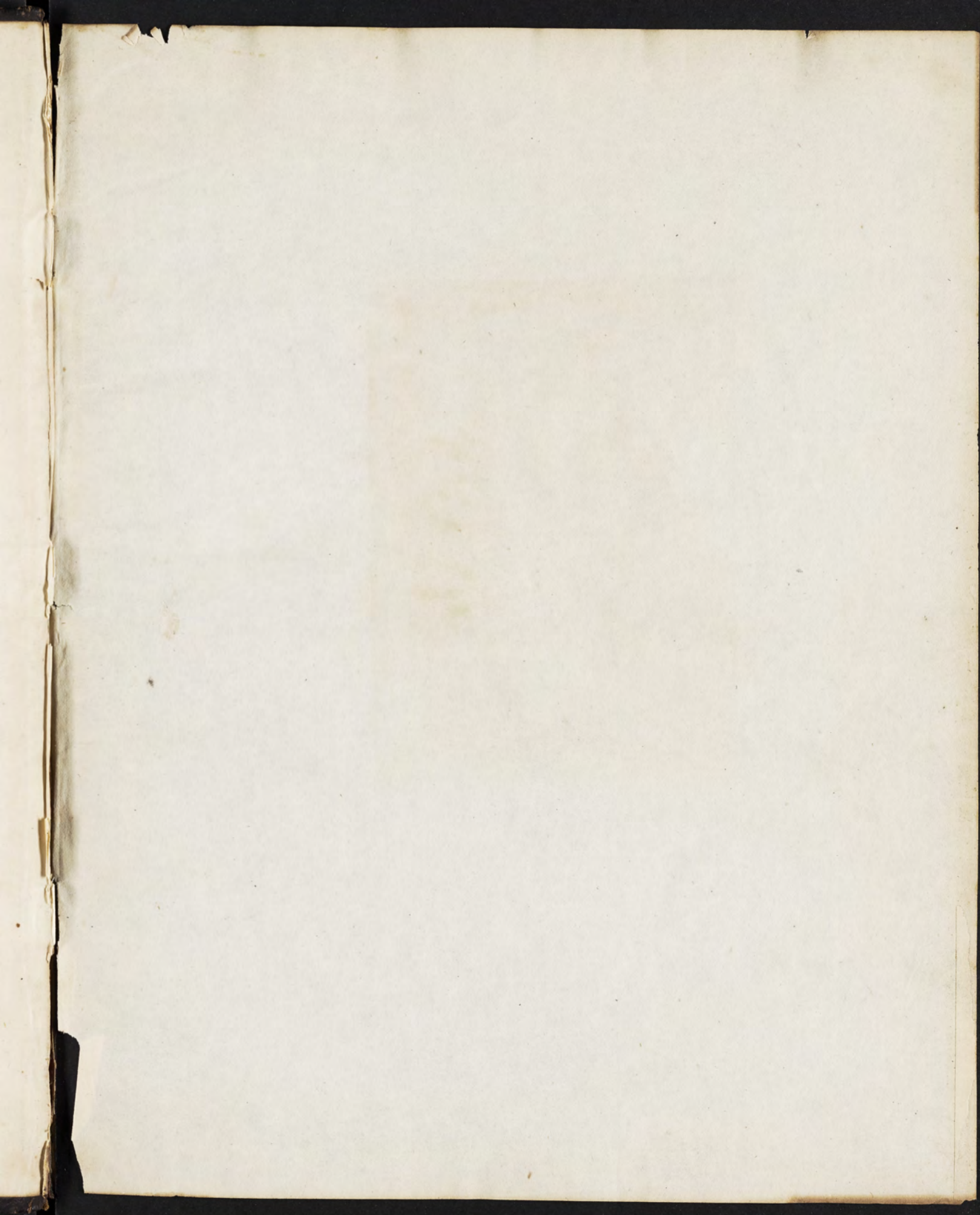


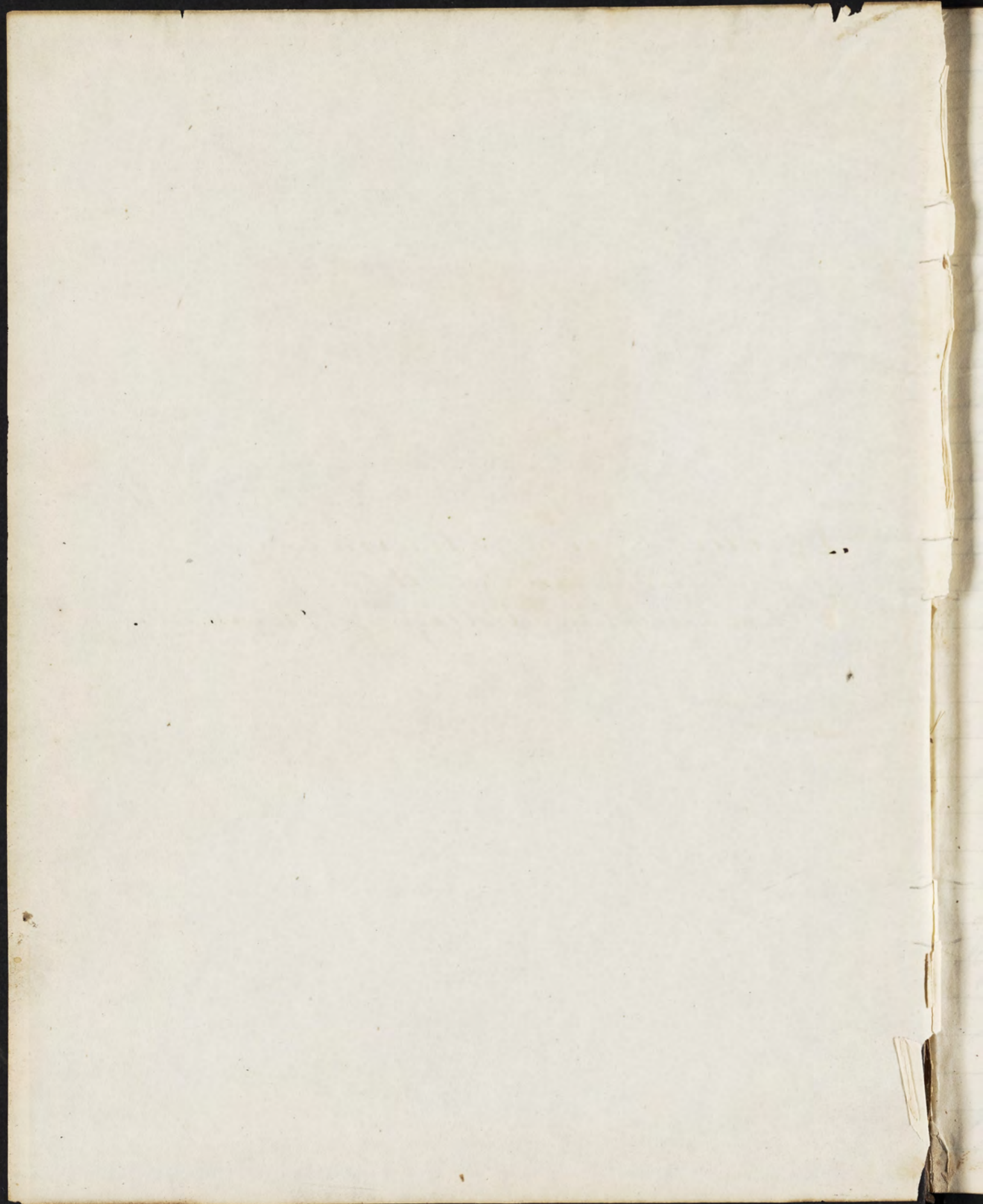
Class

No 17

10a







Lectures on Pharmacy.

delivered in the

Philadelphia College of Pharmacy.

This for.

title Page.

Richard M. Cunningham
Chas. M. Cunningham
Chas. M. Cunningham

Pharmacology, in the comprehensive sense of the term, embraces a complete knowledge of medicines, and of every particular relating to them. It includes their origin and natural history, their modes of preparation and sensible properties as articles of commerce, the methods of preparing them as therapeutic agents, with the changes they undergo, and finally, the circumstances under which they may be advantageously administered. It may therefore be divided into three distinct departments viz -

Materia Medica, Pharmacy, & Therapeutics. To the second of these, I shall direct your attention, in the preliminary lectures of the course, after which I shall pass to the consideration of Materia Medica proper. With Therapeutics it is not our province to engage.

Pharmacy is the science which treats of the modes of preparing medicines for use. It embraces a multiplicity of details. As regards the great majority of medicinal substances, pharmacy commences its operations upon them as they present themselves in commerce, and are brought to the shop of the Apothecary, as

the previous manner of collecting & preparing them is beyond his control. But his knowledge should not be limited to the mere duties which devolve upon him in his capacity of a compounder, he should understand the best methods of securing the efficiency of medicines, and be able to detect the causes of failure, when inert or deteriorated in quality, hence all the circumstances connected with the collection, manner of treating, preparing and preserving substances to be submitted to his manipulations, whether simple as obtained from Nature, or ^{either} compound or modified, as prepared by the manufacturer, should be fully comprehended.

There are certain principles therefore to be laid down, founded upon chemical & physical laws, which constitute the basis of Pharmacy, by which all the practical operations of the Art must be directed. It will be my endeavour to point out and illustrate these principles, thereby presenting as clear and concise an account as possible, of the prominent features of the Science.

Medicines are either Exotic or Indigenous, that is, are derived from foreign sources, or are of domestic origin. There is also a

class of medicines which may be termed Manufactured, but the preparation of which, from the existing division of labour, constitutes the business of the Chemical Manufacturer. With respect to the first and last classes, the duty of the Apothecary does not extend beyond the manner of preparing the substances belonging to them, so as to fulfil the intentions of the Physician, this part of the science of pharmacy, will be treated under the head of Preparations. But all the details appertaining to the second class of medicinal substances, or the Indigenous Materia Medica, the selection, collection, preparation, preservation &c of such articles, constitute a mass of information which it is necessary the Apothecary should possess, as such information will be useful to him, by its immediate application, and by enabling him to understand many particulars inseparable from the two other classes.

These last remarks are more particularly applicable to vegetable productions, as Mineral substances are less objects of care, from their easy preservation, & the facility with which their genuineness & value may be recognised.

The elementary course of instruction which it is my design to present to you, will be arranged under three heads, founded

class of medicines which may be termed
the important, but the preparation of which
from the existing knowledge of chemical
bodies the knowledge of the chemical changes
which take place in the mind and body
during the life of the individual, and the
intermediate steps, the manner of preparing the
substances belonging to them, so as to fulfil
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the science of pharmacy, with the treatment of
the diseases of the human body, but all the
details pertaining to the science of
medicine, and the preparation of the medicines, and
the collection of the medicines, and the
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it is necessary that the physician should know
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These last remarks are, however, not
by application to the subject of medicine, or
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The element of science of medicine
which it is my design to present to you, and
the arrangement of the book, from the

upon the preceding observations.

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Ist - The mode of collecting & preparing drugs as articles of trade.

II^d - The Mechanical & chemical operations which are necessary in the practice of Pharmacy.

III^d - The Forms under which medicines are prescribed for the cure of disease, and usually designated as Pharmaceutical Preparations.

I

The Mode of Collecting & Preparing Drugs.

The first steps necessary, are, ~~and~~ to recognise the several articles of medicine, and to discriminate between them, these are accomplished by a knowledge of their botanical characters, or of their sensible and chemical properties. It is absolutely requisite that a minute investigation should be made into all these particulars, and that accurate information should be possessed, in order to form correct conclusions, so that no deception or mistake may occur; for example, two barks may resemble each other, if the plants from which they are derived can be inspected, no difficulty will arise, or if these cannot be referred to, we must compare their sensible properties. Pale bark and Cascarella

upon the preceding observations.
 In the method of collecting & preparing drugs
 as articles of trade.
 II. The Medicines & chemical preparations
 which are necessary in the practice
 of Pharmacy.
 III. The various matters which medicine
 are furnished for the use of surgery
 and usually distinguished as Pharmacy
 and Surgical Preparations.

I

The Method of Collecting & Preparing Drugs.
 The first step necessary, and it requires
 the several articles of medicine, and the
 circumstances attending them, there are
 considered a knowledge of their nature
 and character, or of their virtues and uses
 is requisite. It is situated, requires that
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 scriptions or instructions may occur for example
 in books may require each other if the plant
 from which they are derived can be traced
 to the different parts and if there is any
 be referred to we must compare them
 with properties. The book and (Dissertation)

are to a certain extent analogous, but upon ⁵ minute examination it will be found that the first, has a fibrous fracture & a tanlike odour, the second has a short resinous fracture, and an agreeable musklike smell, and in like manner of others.

As vegetable substances are now understood to be the subjects of consideration, I shall first present such remarks as are applicable to the collection of plants generally, and then notice separately the several portions of them.

In the collection of plants, that time should be selected when they possess the greatest amount of activity, or in other words, when their medical properties are most active, and exist fully developed, after their growth has attained sufficient maturity, and before they have commenced to be affected by age.

This period varies in the different individuals, from a number of circumstances, all of which should be attended to. It also varies with reference to the different portions of plants, thus the roots, the leaves, the flowers and the seeds are developed successively, and the time to collect them must consequently be extremely diversified.

As a general rule, "Vegetables should be collected fresh every year & those of the last year's obtaining rejected, for

and to a certain extent analogous but from
the same source it is to be found
that the first, then a further further to a
further stage, the second, then a further
further stage, and an opposite, opposite
opposite, and in this manner of other.
The repetition of the same words and then
to be the subject of consideration, which
first present and then as an opposite
to the collection of plants generally, and
then the repetition of the several portions of
them.
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which is a number of circumstances
all of which affect the attention to it.
This is a series with reference to the different
portions of plants, then this is the first, the second
the third, and the fourth, and the fifth
necessarily and the time to collect the
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is a general rule, "The repetition of the
the collected first, every year, and then of
the last year, obtaining reference for

by keeping, they lose their medicinal powers and would only serve, if used, to render the strength of a preparation made from them doubtful and uncertain". This rule may be followed when the particular articles are of easy access, difficult to preserve & the manner in which they have been kept defective, ~~but~~ but it is not invariable.

Besides the age of a plant, the wetness or dryness of the season or time of year at which collected, the kind of soil in which it grows, and the state in which it existed, whether wild or cultivated, are all influential in modifying or destroying its properties.

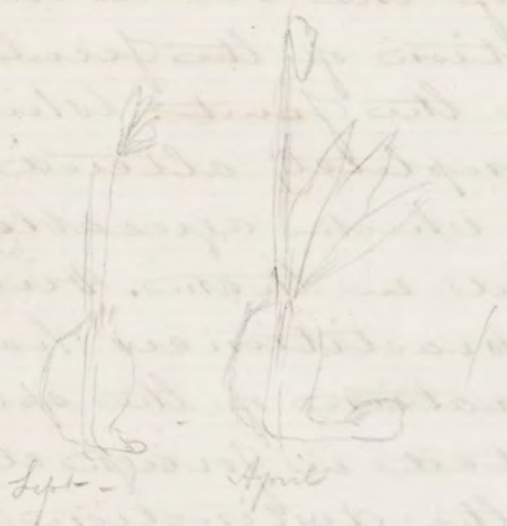
Plants should never be collected for medicinal use during their first growth, their peculiar principles have not been at that time developed; their vessels are filled with inert mucilage and they differ widely in physiological properties and in chemical composition from the same plant at a more mature age; there are numerous examples to illustrate this, thus the several species of Lactuca may be eaten with impunity when young, tender & succulent, before the peculiar milk like narcotic juice has been elaborated, but when this condition has been attained, a sopor-

ripid effect will ensue when taken into the stomach, hence salads which commence to advance towards seeding, should be rejected; "the young borage contains much sulphate of lime, which salt in the full grown plant disappears & is replaced by nitre, the negroes eat without injury - the young shoots of the apocynum, & the Tuscans those of the clematis; and in Sweden the young leaves of the aconitum are eaten with relish as a salad". It is useless to multiply examples.

Vegetable productions are for the most part of better quality, when obtained from the countries of which they are natives, as when transplanted they are liable to become degenerated & lose their characteristic properties from the want of some particular principles upon which these depend. The influence of soil in the changes which it is capable of producing upon the activity of plants is also remarkable, the umbelliferous tribe afford an instance of the effects of soil; if ~~this~~ this is dry & destitute of moisture, they have decidedly aromatic properties, but if low & marshy, narcotic virtues are developed & they become poisonous, the Conium maculatum is a remarkable instance, In the Crucifera it is stated to be eaten with impunity.

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Cultivation also is productive of considerable variation in the properties of plants. In some cases it diminishes their activity, in others it increases it, thus the ~~cultivated~~ digitalis of the Shaker settlement, where it has been introduced & is cultivated, is in general inferior to the English. Our domestic vegetables & most of our esculent fruits are increased in value by cultivation, as in them there are principles developed which render them fitted for nourishment, thus the Potato & many of the same kind are changed by an augmentation of the fecula in their roots or ~~in~~ ⁱⁿ the fruit. While the apple & pear are completely altered by the addition of sugar which agreeably combines with the malic acid in them. Virey remarks ⁹ that the ancient practitioners had noticed the obvious deterioration of the species of vegetables cultivated in foreign climates, but did not draw the distinction between the effect due to culture alone, & that which was attributable to change of climate; they concluded that in general natural vegetables were preferable to those which were cultivated for medical purposes, but in this they were often deceived, for experience has demonstrated, that the culture of vegetables in soils which are appropriate for them, instead of being injurious, adds to their



properties. For this reason, ⁹braciferous plants, Labiate & umbelliferous ^{plants} have more sweetness more odour & furnish a greater amount of volatile oil, when carefully cultivated in places which are congenial to them, than when they grow wild."

There is some difference among vegetables as to the time of year when they should be collected, & this may even differ for each part of the same vegetable, thus as we shall see there are some plants which must be collected in spring, others in summer & others again in the autumn. & it is ^{very} ^{important} ~~concerned~~ ^{should} that the different parts of them ^{full} ~~are~~ be collected at the periods of their development, which is progressive. The Colchicum autumnale will illustrate these remarks; thus, this plant puts out its leaves in April & flowers in September, about which time the new bulb begins to be thrown out from the old, now it is important to take the bulb from the ground when it possesses most activity, which is in July or August, between the leaves & the flowers, before it has become exhausted, and as the fruit is formed late in the autumn ^{the seeds} ~~it~~ are not fit for use until the next year.

From reference to all these circumstances, it is necessary to be careful in the selection of drugs, and a knowledge of their will mutually assist in avoiding disappointment, ~~as there~~.

Gartling

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It is generally necessary that drugs should be gartled when they come into the hands of the Apothecary, and this operation consists in taking from them certain portions, which are destitute of properties, injure their appearance or are positively injurious. Thus in many cases, the radicles are removed from the roots, either of which may be destitute of properties and interfere with the strength of the article. Stems & extraneous matters are removed from leaves, Peduncles from flowers, Pericarps from fruit. Capsules from seed &c. It is also necessary that imperfect, immature or mouldy roots, leaves &c should be removed, and in general that earthy and foreign substances should be separated.

Dessication

This is a most important operation, as upon the proper method of performing it, depends the subsequent value of the article. Plants are by drying deprived of their watery portions, in order to prevent mouldiness & decomposition by which their virtues would be injured or destroyed. Water is as indispensable as air to all living beings. The seeds of vegetables are composed of organs, which in order to develop themselves, require the presence of moisture, this is obtained from the earth, the portion of this water is reduced to its elements

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which enter into the composition of the plant, another serves as the vehicle for these same components & carries them to every portion of it; this is called water of vegetation, and as it is necessary to their vital existence, so when the vital principle is removed, it forms the basis of putrefactive fermentation. The principle upon which desiccation depends is the evaporation of ^{the} water, which may be accomplished naturally or artificially & must differ according to the nature of the vegetable matter. Plants are usually dried by being hung up in the open air or by being exposed to the heat of a stove in an airy chamber, both of these methods are liable to abuse, "ceteris paribus the more expeditiously the process is performed the better, and the odour & colour of the vegetable should remain uninjured, if the desiccation has been properly executed"

Roots

Nearly all authors agree in directing that the roots should be removed from the earth when the stalks & leaves have decayed or before they have shot forth, this rule is in general ^{a good one} but it requires to be modified according to the duration of the vegetable.

If the plant be annual, it is evidently improper to wait for the destruction of the stem & leaves before the root is taken, as the whole plant

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dies at the same time; it is consequently requisite to select the time when it contains all its active principles, & this is ^{when} its juices are not solely those required for its own nutrition, but when its active constituents are fully elaborated.

"When a plant is biannual, it is still during the vegetation of the first year, little supplied with its peculiar principles, but contains a large proportion of water. During the summer, its juices become concentrated, & when the stem & leaves die down, the sap returns to the root & communicates to it all the properties ^{which} it is susceptible of receiving, this is during the autumn & winter, which are the best seasons to collect the root. If however left until the next spring, a retrograde movement takes place, the roots shrink & enlarge in size & sometimes split, from the absorption of water. This state of fullness has imposed upon many authors, & has led them into the error of selecting them in this state.

Thus Baume states "that experience has demonstrated to him, that spring roots diminish by drying one half more than autumnal roots, especially such as are large & fleshy.

Besides in drying they undergo a slight degree of fermentation in consequence of the water they contain"

The roots of perennial plants should be collected after the fall of the leaves, after two or more years, at which time they have

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acquired their extreme perfection. Still later they become too lignous & large & subject to diseases which alter their properties. The rhubarb is an exception, it is taken when five or six years old.

Kane in his elements of Pharmacy gives a good account of the desiccation of roots. It is evident that this must differ according to their nature; if they are fibrous & hard, the adherent dirt is to be removed by washing, and the fibrous and neck of the root cut off, the latter is removed in order to deprive it of life & prevent an alteration of its properties by germination. The body of the root in some instances is cut into slices in order to facilitate the escape of the moisture, particularly where there exists a thick, tough, epidermis & the root itself is voluminous.

Roots should be carefully washed previous to desiccation, as it is difficult afterwards to remove the adherent dirt, by this means also some mucilage is removed which would tend to produce mouldiness. Aromatic roots should not be scraped in cleaning as in their epidermis resides the active principle. It is not always the same part of the root which it is important to preserve; in some as the Aquilegia & wild cherry it is the bark, — in the contrary with respect to the Althea officinalis it is the inner portion or medullary —

which is to be retained.

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"In the desiccation of Fleshy roots more caution is to be observed, having been washed & cut into thin slices, they are to be strung on cords and dried partially by a current of air or the sun, when once moderately dry, the desiccation may be finished by the heat of a stove, but if they had at once been submitted to that temperature, they contain so much water that fermentation might readily ^{be} excited."

The only tubulous roots dried by the apothecary are the squill & colchicum. The former is deprived of its proper root, at the base of the bulb, which is then cut transversely with a silver knife, as if a steel instrument is used the Lassarieu is apt to act upon it & distort the sections. the inner scales are alone to be preserved. when dried, ^{if in so doing it is necessary} gradually increasing the temperature. The meadow saffron if intended for keeping should be dried immediately on being obtained; it should be cut into small pieces & desiccated rapidly at a temperature of 130° ; it is tenaceous of life & if its moisture be not quickly & ^{perfectly} removed it germinates, its veratria disappears, & when its stock of nutritive material has been exhausted, it shrinks, dries & is decomposed.

Buds are collected & dried when they are in a full state of maturity which is the spring.

The stems of the *Solanum dulcamara* are almost the only ones used, they are collected in autumn after the fall of the leaves & the growth of the last summer are selected, they are cut of appropriate lengths & dried gently. Almost the same directions are given for the collection of woods—

Barks should be collected at the season they can be most easily separated from the wood. The French Codex directs the barks of shrubs to be separated in autumn & those of trees to be removed in the spring. The law however may be stated to be ^a that Barks should be procured either before flowers are produced, or after the fruit has been perfected, during these processes all the powers of the plant are employed in elaborating the organs necessary to them & it is only before the commencement of reproduction or after it has been finished, that the other parts of the plant are suitably supplied with juice. Trees neither too young or too old should be selected, for when barks have arrived at a certain growth they become unfit for medicinal use, they split grow hard & the quantity of soluble matter in them becomes diminished. These facts are constantly illustrated in the shops. The method of drying them does not call for remark.



Johns River + House

The house is situated on the left bank of the river, about a mile from the mouth of the river. The house is a small, one-story building, with a gabled roof and a chimney. It is surrounded by a small garden, and there is a well in the front yard. The house is in good repair, and the interior is comfortable. The view from the house is very fine, looking down the river towards the mouth. The river is very wide, and the water is clear. The banks are covered with trees and shrubs. The house is a very nice place to live, and it is well suited for a family. The price is very reasonable, and the house is in a very desirable location. It is a very good investment, and it is well worth the money. The house is a very nice place to live, and it is well suited for a family. The price is very reasonable, and the house is in a very desirable location. It is a very good investment, and it is well worth the money.

Leaves are in their most vigorous condition before they become hard & dry & after they lose their mucilaginous & viscid nature, the proper time for collection therefore is before flowering or at least before the maturity of the fruit, for when these parts are advanced, it is at the expense of the leaves. But when the leaves partake of an aromatic principle with the flowers, which becomes augmented & more active as the plant approaches the flowering state, it is evident that this time must be allowed to arrive before collection. It is also to be observed that in these plants, the aromatic principle increases from the base to the summit, so that the ^{upper} ~~superior~~ parts differ little in qualities from the flowers themselves & advantage is obtained from collecting them together, this has given origin to the name flowering summits.

M^r Cotton has remarked with respect to the leaves of biennial narcotic plants, that they do not possess medicinal activity until their second year & that a great part of the leaves of the *Scyoscyamus* collected for sale are of the first year growth, mucilaginous & inert. These being mixed in unknown quantities with the active leaves & sometimes even being used alone, must make an extract or a tincture prepared from them very variable indeed.

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The desiccation of leaves must be conducted so as to preserve their original colour unaltered, as this is the most certain test of their retaining their active properties unchanged, to effect this they must be excluded from the solar rays & the heat used must be cautiously applied.

Flowers

Flowers are to be gathered recently blown, the French Codex recommends them to be gathered before they are entirely expanded which is a good rule, as the time during which the flower is in its prime is very short & it is better to anticipate this time a little than let it pass. The mode of inflorescence, the size of the petals, the adherence between the different parts of the flower & modify in some instances the method of collection. I may cite a few examples. Red roses are collected when they are hardly more than buds, because in this state their astringent principle is in greater amount than when completely unfolded. In the compound flower as the chamomile, the white flower is collected invested with the outer covering or calyx. In the red poppy the petals are selected, &c.

It is extremely difficult to dry flowers so as to preserve at the same time their colour and odour, those of which the petals retain —

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much water and at the same time an odoriferous principle, as most of the cruciferae are incapable of desiccation. Most other flowers may be dried like leaves. Some dense flowers must be allowed to remain exposed to heat a considerable length of time, otherwise a certain quantity of moisture will be retained in their interior, which will cause fermentation in them when packed.

Fruits & Seeds

In common language the name fruit is given to that kind of production which is edible, nutritious & agreeable, these are usually fleshy & juicy, but there is another kind of fruit which is dry & hard. In an exact sense, the fruit is the part of the plant which follows the flower, from which it results & contains the rudiments of the future plant, or seed; it therefore consists of several parts - all included under the term.

If the fruit be fleshy, within its pericarp or investing membrane is contained a quantity of cellular tissue, holding the juices which give it flavor & agreeable properties; if it be dry, this cellular tissue is destitute of juice.

If fruits are to be used fresh they should not be collected until perfectly ripe, as for instance the lemon, if the virtue resides in

much water and at the same time an
inferior forerunner as most of the
instruments of dissection. The
may be used like a saw to
cut the surface of a bone
or curved blade for the purpose of
cutting out of the surface with the
instruments which will cause
the surface to be smooth.

The next is a pair of
instruments, large and small, which
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and the small one is used to cut
out of the surface of a bone.

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the bitter & astringent principles, they may be collected before maturity, when the tannin is in greatest amount, as the *Pomegranate*. the external rind of which is most rich in these principles in this state. but that of the orange should be separated from the ripe fruit. Seeds are to be collected as soon as they are ripe & before they begin to fall from the plant. The London Pharmacopoeia directs that they should be kept in their own seed vessel.

Some rules are necessary in determining the maturity of seeds. - The following will guide us.

The farinaceous seeds, as wheat, barley, oats &c are mature when they are heavy and separate easily from the scaly coverings which invest them.

The emulsive seeds as the almond peach &c when the pericarp is full & the fruit does not become milky from pressure.

The Aromatic seeds as ~~cassia~~ away, coriander, fennel &c when the axes which support them, in the umbelliferae become dry & brittle, the umbels nearer to the bottom of the stems are soonest matured.

In the case of dry fruits, whenever the seeds rattle within the capsule, they may be considered as mature, as this is owing to the breaking up of the connexion between the seed & the part of the capsule from

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which it is nourished, & nutrition has come to a termination.

The seeds of fleshy fruits are mature when the fruit itself is ripe.

The rules to be adhered to in drying fruit & seeds are the same as for the other parts of vegetables & call for no particular remarks.

The preservation of vegetables when once dried requires some attention, those which originally contained little water may be kept for any length of time uninjured, others on the contrary become deteriorated rapidly and require renewal. The means by which dry vegetables become unfit for pharmaceutical use, is by the destructive effects of insects, or by the supervention of fermentation. Such as contain much starch are particularly exposed to the first. Leaves, fruits or flowers, which are of loose structure, contained much water & have a cellular tissue with some saccharine principle are most likely to undergo fermentation from the absorption of moisture. The roots & barks which are mucilaginous or merely bitter, as althea, columbo, become inert & useless when attacked by insects, and should be rejected, but where a root is resinous, its virtues are not rendered less, but rather relatively greater by the inert material being removed by the

animal which leaves the active principles untrunked; this is the case with jalap & some few other roots.

There are two methods of preventing vegetable matters from absorbing moisture & thus preserving them unaltered; the first of keeping them in close vessels.

The second is to compress them to such a degree as, in a great measure, to destroy the flaccidity & porosity of their tissues. In this way the digitalis - Boneset and other medicinal plants are packed by the Shakers, hops are compressed in the same way, only in large quantities. If however the drugs are not thoroughly dried before compression is made, they are subject to fermentation, mould & decay.

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Nearly all the processes & manipulations of Pharmacy have for their end the formation of Medicines, and these processes consist of the best devised methods of reducing & modifying the simple substances which are derived from nature, so that they may be rendered suitable for the purposes to which they are to be applied; hence those operations to which drugs are submitted, of which I shall present an account in the present Lecture may be termed accessory. By these processes some change is effected either in their physical or chemical characters, imposing forms upon them by which their medicinal virtues are better developed & rendering them of easy adaptation to the fluctuating circumstances attending disease.

There are four different methods of modifying simple drugs, which form as many principle modes of preparation; these are division extraction mixature & combination. Division produces separation between the particles of bodies supposed to be homogeneous. That is to say, a body, whether simple or compound, possessing homogeneous particles, is reduced by means of mechanical force, so that these particles are rendered as fine as possible, without changing their homogeneous nature, one particle being the same as another, for instance Rhubarb & Creta preparata

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Extraction produces separation between the heterogeneous particles of substances. By this ^{it} is meant, that extraction separates the constituent principles of substances, or abstracts from them such as are required for specific purposes & leaves such as are not wanted. By this means more activity is concentrated in ^{any} given preparations, without the presence of ~~effete~~ ^{and no} matters which interfere with their properties, by obtaining in an isolated form, efficient principles unaltered ^{but} as they exist in the substance operated upon. For example, the extracts.

Mixture leads to a union or combination between the particles of bodies, which is mechanical, by it no change is effected in the constitution of the particles themselves, they are the same after mixture as before. Thus the solution of a salt in water is a mixture.

If however the bodies brought together have an affinity for each other & can form a new compound different from either, they are said to enter into combination & this is regulated by chemical laws, thus iron & sulphur brought in contact, with the aid of heat, will form a new compound sulphuret of iron.

Each of these four methods of preparation is divided into a certain number of particular methods, technically denominated Pharmaceutical Operations. The same substance is frequently submitted successively to

* Mercury when rubbed with lard is sometimes said
to be extinguished.

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several of them before it is fitted for use. I shall now notice these operations under the head of each method spoken of, and first, of the operations by which division is effected. Division was stated to be a separation between the particles of a body supposed homogeneous.

When a substance as silica or an analogous mineral body, is heated sufficiently & then plunged into water, its state of aggregation is changed, its particles have been so far separated from each other by caloric, that when this is suddenly removed, they cannot return to their same relative position & the substance becomes disintegrated or friable & may easily be pulverized; this is called Extinction & is usually applied to hard bodies which would resist other means. The sense in which this term is here used is perhaps its best application. Granulation is performed by aid of heat & is usually applied to metals, but is rarely made use of in pharmacy. Thus lead or tin when in fusion is poured through a strainer & the particles caught in water, or they may be poured into a box containing chalk & shook until disintegration takes place.

Section In this process, cutting instruments are made use of, which are of several forms according to convenience or the force necessary to be applied, under this term may

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also be included, ^{rasping} ~~filing~~ & grating. Woods and substances containing woody fibre are subjected to these operations.

Pulverization is an operation by which, with the aid of mechanical force, dry & solid bodies are reduced to powder, the cohesion between the particles having been overcome.

The most common apparatus by which pulverization is effected, is the pestle & mortar, the force necessary to be used & the direction of it are expressed by the terms contusion & trituration. Contusion consists in putting the body which is to be reduced to powder into a mortar, and striking it strongly with the pestle, in order to separate its parts, this mode is used for all those dense materials, whose molecules adhere strongly together & are not susceptible of being softened by heat. "The design of contusion is to break down large masses of hard bodies into smaller ^{particles} & thus prepare them for the tritulating action of the pestle, or to reduce substances, whether vegetable or mineral to a coarse powder, which is better adapted to be acted on by solvents. Trituration is practised when it is the object not merely to reduce bodies to coarse particles, but to obtain them in the state of a very fine, or as it is commonly termed, an impalpable powder, in this operation rotatory friction is made use of & friable matters are those upon which it

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is employed, resinous substances for instance. When substances are continued or triturated, the finer portions are dissipated in the atmosphere & a greater or smaller amount of loss is experienced & if the substance be acid it is apt to produce unpleasant effects upon the operator. At one time it was the custom to add to the substance a little water, oil, or even some sweet almonds. Baume has proscribed these additions with good reason; ^{as} water retards considerably the pulverization, & affords moist powder, which does not keep, oil and almonds become rancid & communicate bad qualities to the powder; if possible, then, powders should be formed without any addition & the mortar may be guarded by means of covering of various kinds.

Pulverization is said to be mediate when an additional substance is added to facilitate the reduction. There are many substances which when submitted by themselves to the action of the pestle, cannot be reduced to powder, on account of some peculiarity inherent to the substance itself & it becomes necessary to counteract this peculiarity, this is done by the agency of some material possessing this power, but at the same time, not interfering with the medicinal action of the body required to be powdered, or chemically incompatible. Some examples will illustrate this operation. There are some bodies —

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chiefly vegetables, which are so dry, so tenacious, & so membranous, as agaric, colocyth &c that by themselves, they never could be reduced to powder, it is therefore necessary to treat them in the following way, mix them with the mucilage of tragacanth by beating them up together until they form an homogeneous paste, which when dried can be easily reduced by mere trituration into a fine powder. Some bodies resist pulverization from their elasticity, as for instance camphor, which is rendered easily fusible by the addition of a few drops of alcohol. which loosens the adhesion between the granules. "Many organic products form when rubbed in the mortar a kind of paste," as resins, gum resins & gums, in some of these it is sufficient to operate at a low temperature, the cold being capable of keeping them friable; but ~~on~~^{to} others some substance must be added capable of keeping the particles separate; the pulp of the fruit of the Epidendrum vanilla is directed to be powdered by mixing it with four times its weight of sugar, the powder thus obtained being capable of being sifted. In cases where it is only wanted to prepare the substance for the action of some solvent, glass or sand being pulverized with it will answer very well & not being acted on by the fluid, the substance is dissolved away pure from it, thus can resinous substances be prepared for solution

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in alcohol at any temperature. There is a beautiful illustration of mediate pulverization, in the method adopted to powder metals, which on account of their ductility cannot be reduced to powder immediately. Gold or Copper are taken in very thin laminae, mixed with honey or sugar & rubbed together until the metallic appearance is nearly removed, when boiling water is poured upon the mass, which dissolving the honey, leaves the metal reduced to a very fine powder. The reduction of Mercury is also an example.

Pulverization by friction. This operation is seldom performed, as the substances operated on, can be reduced by trituration. It is applied to substances such as ceruse, Magnesia chalk &c which are soft & friable & which when placed upon a sieve file up & obstruct its ^{pores} but by applying friction against the wires of the sieve they are forced through & no unequal particles are left.

Under this head may also be placed the operation of grinding. Mills are employed of different constructions, those however which operate by means of friction, are formed of horizontal stones which revolve upon each other, the substance being introduced between them. In this way the different kinds of seeds are powdered, whether dry or oily. The latter are however rather mashed than ground, as lin seed. Some mills only break the substances by pressure.

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Porphyzation derives its name from the instrument used in the operation, the material of which it is formed being porphyry. The substances are submitted to the triturating action of two surfaces, one a perfect plane, the other a concave segment of a very large sphere, the latter surface is the base of a cone, termed the muller. In this case, it is requisite that the substances should be reduced to powder previously, and they may be operated upon either in the dry state or moistened with water. — Paints are prepared in this way.

There is a similar operation which is termed Levigation, but which differs from the above. There are some substances which are naturally presented to us in very fine powder, but mixed with other bodies less minutely divided, which it is necessary to separate in order to have the substances we want pure. After they have been rubbed with water on the stone, with the muller, or in a mortar, they are mixed with water & disseminated through it, when allowed to remain at rest, the coarser particles first settle to the bottom & the finest are the longest in becoming deposited. Now by taking advantage of this fact, the finest particles can be decanted from the coarser after they have subsided, which process is called clarification. And the impalpable nature of the product will depend upon

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the length of time, the liquid has stood. It is afterwards dried upon bibulous paper by heat. In this way ^{are} prepared Chalk, Carbonate of Iron &c which when moist are moulded into cones. Sifting is an operation of considerable importance in pharmaceutical practice. It is performed by means of sieves of different powers, proportioned to the fineness of the substances required. By agitation in a sieve, the finest particles are separated from the coarsest & an uniform state of disintegration is the result. It remains for us to make some remarks upon mechanical division in general with regard to its uses & the peculiarities of different substances which are subjected to it. The uses of mechanical division are of two kinds; first, of facilitating chemical action, and secondly, of rendering more convenient the ^{administration} ~~administration~~. As an ^{example} ~~instance~~ of the former, the Seidlitz Powders may be instanced. Of the latter, in the application of solid substances to the skin, as tartar emetic, or cantharides, the degree of effect produced depends on the degree of mechanical division of the substance ^{which is} used, and in the application of sulphate of quinine to the skin, if not still more reduced than it occurs in commerce, it is apt to irritate & interfere with its absorption, hence the coarseness of the particles must be removed by trituration with Sugar.

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Before a substance be powdered it should be thoroughly dried. Opium is one of those substances which cannot be powdered when fresh, & the reason is, that the gum contained in it, is in the state of mucilage, rendering the mass plastic, but when the gum has been deprived of its water by drying gradually, the mass is rendered brittle & can be disintegrated. It is also difficult to powder some of the salts, on account of the water of crystallization that they contain, which if driven off of itself reduces them to the state of powder. Exsiccation must therefore be practised for all the efflorescent salts.

Care should be taken in powdering to separate inert portions & impurities, and to mix intimately the whole of the powder which is reserved for use. The central woody fibre of *Specacuantha* and other roots, the virtues of which reside in the cortical portion should be rejected. The exterior coating of barks are inert, as they are dead when removed from the plants & as they may be covered with lichens, they ought to be removed, as these only increase the substance without adding to the strength of a powder. With respect to aromatic seeds, the investing membrane contains the volatile principle & is to be retained

*The weight of the powder obtained is never equal to the weight of the substance used, the loss depends upon the quantity of matter driven away by manipulation & that not reduced to powder. A table has been made of the loss sustained by different substances by M. H. Henry & Glibert for an abridgement of which I must refer you to the U.S. Dispensatory.

Torrefaction is usually accomplished in iron vessels, with constant agitation. Sometimes volatile aromatic principles are developed by this operation as in coffee.

the inner portion is albuminous*

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Extraction

Extraction is a mode of preparation, which produces separation between the heterogeneous parts of bodies, so that the products which are separated & those which are left, are different from the bodies themselves, although they contributed previously to their formation. The actions which take place in extraction are chemical in their nature.

By exposing soft & succulent substances to a sufficiently high degree of heat, the watery particles are removed & some degree of alteration takes place in the solid elements of the body; the term Assation has been applied to this process by Messrs Henry & Guibourt, but it differs little from the process of Torrefaction in order to accomplish which dry bodies are exposed to the action of moderate heat, for the purpose of volatilizing or modifying some of their principles; for example, Rhubarb is torrefied, in order as is believed to alter the purgative principle & to increase the power of that which renders it astringent. bity seeds are torrefied in order to dry up the mucilage, which otherwise would be mixed with & dilute the oil, rendering it less efficient & making it less easy of extraction; for example Castor oil; the differences between cold pressed & hot ^{only} pressed are apparent.

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Fusion is an operation ^{during} ~~in~~ which a body passes from the solid to the liquid states, by aid of caloric. The law by which it is produced, depends upon the power caloric possesses of insinuating itself between the particles of matter and separating them from each other, overcoming the power of cohesion. Fusion is of two kinds, aqueous & igneous. The first occurs when the water contained in the body accelerates ^{fusion} ~~it~~ is operated upon by the caloric, it is employed, when it becomes necessary to remove from salts a part of their water of crystallization, or to obtain them under a different form. The second or igneous fusion is employed to separate fusible substances from others which are less so & which alter their purity, as for instance the metals. Crucibles are usually employed. It is also employed ^{upon} ~~with respect to~~ many substances for the purpose of straining them & separating impurities, as tallow & wax, to the operation as applied to these, the term liquifaction is applied, but as it comes under the head of the application of heat it may be considered as fusion. The amount of heat differs in various substances, thus ice fuses, at one or two degrees above freezing point. Mercury still lower, phosphorus, wax &c at a low degree, while the solid metals for the most part require very elevated temperatures to fuse them. Some bodies are infusible.

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while others cannot undergo, fusion without decomposition, as marble; though Mr Hall has proved that if measures be taken to prevent the escape of carbonic acid, it may be fused. There are two invariable laws in the fusion of bodies. 1st "that they remain solid until they have arrived at a certain temperature, which differing for each substance, is constantly fixed for the same substance & it is only on reaching this temperature that fusion commences. 2d that ^{when} once fusion has commenced, the temperature remains the same until the last particle of solid matter has been liquefied, no matter what quantity of caloric may be supplied to it."

Fluxes are sometimes employed in the fusion of bodies. as green tartar, borax, sulphate of potassa & nitre. they materially assist in separating metals from their ores.

Sublimation is that operation, which by the intervention of heat, separates parts of substances which are volatile & pass off in the gaseous form, but are again condensed into solids when the heat is removed. The vessels in which it is performed vary in shape, being sometimes retorts with wide necks, occasionally matrasses, the mouth of which are loosely stopped to prevent loss, while the sublimed substance condenses in their upper part, an alembic is sometimes used, when

liquids are at the same time liberated, for while the sublimed substance condenses in the head, the fluid is discharged by the pipe, an aperture of some kind is necessary in almost all apparatus for sublimation, in order to relieve the too great tension of the gaseous matter. Substances obtained by sublimation are generally met with in masses of a shape representing in some degree the form of the vessel into which they have been sublimed, ^{they usually take that of} in hemispherical or conoidal cakes, ^{which} they are smooth and shining on the outer surfaces from having been in contact with the polished internal surface of the subliming vessel, and on their internal surface present an approach to crystallization more or less perfect, according as the process had been conducted with greater or less rapidity. It is considered in commerce an advantage for the sublimed masses to possess a degree of translucency which is given to them by increasing the heat towards the end of the operation, so as to allow the material condensed in the capital to undergo a commencement ^{ing} of fusion, this is particularly ^{practised} done with sal ammoniac, camphor, the two chlorides of mercury & arsenious acid; in the latter substance it is probable that some other change than mere fusion is effected, as Guibout has found the opaques

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and semi-transparent varieties of sublimed arsenious acid to differ considerably in their relative solubility in water. Sometimes the products of sublimation assume the crystalline form without solidification into masses, as Flowers of Benzoic & sulphur. An elegant preparation of calomel is obtained by condensing its vapour in a vessel filled with the vapour of water, by which the particles are arrested & precipitated in the form of an impalpable powder, this process was first invented by Sewell & has since been improved by Henry.

Many substances are volatilized in the atmosphere without the intervention of a close apparatus, as arsenious acid & impure oxide of lead, by roasting the ores of arsenic & lead. these however belong to oxidations.

Distillation is the ^{process} operation by which volatile matters are separated through the intervention of heat, from either solid or fluid bodies, & condense by cooling into liquids; close vessels are made use of, one of which is heated & contains the substance to be operated upon, the other refrigerated to collect the product, & they are closely united together through the intervention of tubes, retorts with receivers, alembics & stills are examples of the kind of apparatus used. & heat is applied by means of

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furnaces, lamps or baths. The recipient condensing vessels are termed refrigerators or receivers. Wolf's apparatus is one form of it. The worm of the common still answers the purpose of a condenser.

The rapidity of condensation depends upon two ~~things~~ ^{circumstances}, by attending to which greater facility is attained. the first is the constant application of cold, the second the extent of surface.

The purposes to which distillation is applied, are purification & extraction.

Water is purified by distillation; the impurities of water are numerous salts which remain behind with the water left in the still, the carbonic acid however comes over with the first portions of the water & detaches them, they are consequently directed to be rejected, as this is uneconomical, a little lime added to the water before the operation has been commenced, obviates the necessity of their rejection as it absorbs the acid.

Sulphuric acid & vinegar are also purified in this manner.

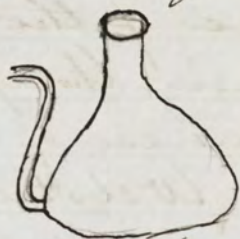
It is by extraction that distillation discharges the volatile oils from substances in which they are contained, in consequence of their volatile nature. The volatile or essential oils form a most important

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class of vegetable products, the nature of which
will be pointed out in the proper place.
One of the most important points to be attended
to in the preparation of volatile oils is the avoid-
ance of empyreuma, a plan has been devised
by Webster for this purpose, which is to suspend
the vegetable matter by means of a wicker basket in
the ~~stille~~, and not allow it to come in contact with
the bottom, in this way it is exposed to the vapours
of the water, which passing through it, extracts
the oil & carries it over into the receiver where
both are condensed. It has also been proposed
to effect the distillation in vacuo at so low a
temperature as to render burning ^{the substance} impossible.
Mr Barry ^{of Ed} prepared in this way some very elegant
oils.

Chevallier has laid down the following rules
to be observed in the distillation of volatile oils.

- 1- To operate upon large quantities in order to obtain more product & of better quality.
2. To conduct the distillation rapidly.
- 3 To divide the substances minutely, in order to facilitate the exit of the oil which they contain
- 4- To employ only water enough to prevent the plant from burning.
- 5- For substances whose oil is heavier than water, to saturate the water in the still with common salt which raises the boiling point & enables the aqueous vapour

* The Florentine receiver is a vessel formed like a decanter, growing narrow toward the neck; from the bottom a pipe arises along the side of the receiver, but does not go so high as the neck. By this construction, the lighter oil collects in the neck, and the heavier water goes out by the opening of the pipe in proportion as the distillation proceeds.



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to carry over more of the vapours of the oil.
b - To employ water which had been already distilled from off the same substances & had thus become saturated with the oil.

7 - To use for oils of a specific gravity below 1 - a Florentine receiver.*

8 - For the oils naturally fluid, to cool the fluid in the refrigerator frequently, but to retain it at 80° or 90° for those oils which easily become solid as those of roses anise &c.
Distillation is also used for obtaining the volatile products which result from the decomposition by heat of substances of animal or vegetable origin. The oils which are obtained in this manner, are called empyreumatic. This properly speaking is destructive distillation, as the products are formed by the exertion of new affinities, and it does not come under the head of simple separation. In the distillation of wood, the products are, pyroacetic acid, acetic acid, tar & carbonated hydrogen. In the distillation of amber, the volatile oil of amber & succinic acid are the products, the former is produced by the decomposition of the material, the latter naturally pre-existed in the amber, & is merely separated in consequence of its volatility. The amber is mixed with sand.

When animal substances are thus acted upon, volatile alkali is the resulting product.

Lecture III

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Medicated or Distilled waters.

A Medicated or distilled water is such as holds a certain quantity of the volatile & aromatic principles of a plant in solution; there are two methods of obtaining this class of preparations - 1 by distilling the water directly off the vegetables - 2d by using the oil already separated from the plants & distilling it over with the water. I shall return to these under the head of preparations.

Alcohol possesses more or less purity in proportion to the extent to which distillation is carried.

There are several names given to distillations - derived from the objects of it & the manner of conducting it.

When the design is to purify a liquid & render it stronger, it is termed rectification, this is usually a second distillation, hence the term rectified spirit in the case of alcohol. Now rectified spirit, besides being diluted with much water, always contains an oil, to free it from which & to obtain it in a more concentrated state is the purpose of rectification.

Cohobation is the new distillation to which a liquid is subjected, after having been poured upon the marc or a new quantity of the same substance, in order to become more charged with its volatile principles.

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Dephlegmation is a term used for the redistillation^{fluid} to which substances obtained by destructive distillation are submitted in order to drive off certain portions, chiefly aqueous, called the phlegm. It is usually done with^{out} the intervention of the atmosphere, & in close vessels, in which respect it differs from evaporation, the important product is the one left behind.

Extraction is also accomplished by —
Solution or Mediate Signification The object of this operation is to break down the force of aggregation which unites the integral particles of a body, by means of a liquid, which interposes itself between them & separates without decomposing them. The most universal solvent is water, many other fluids also act as media of solution, as alcohol, ether oil &c. The following explanation has been given of the phenomena of solution. It is supposed that there exists a certain chemical affinity between the solid & the fluid, to the ^{action} exertion of which is opposed the cohesive force of the particles of the solid, where the power of cohesion is superior to the force of affinity, the solid remains insoluble; where the affinity is more powerful, it is soluble in the fluid & according to the greater or less predominance of this force of affinity, is the solid body more or less easily dissolved. This affinity diminishes as the fluid dissolves ^{successive portions} more of the

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solid, until at last it is so far weakened as to be unable to overcome the force of cohesion of the solid, the rest of which remains undissolved & the water is said to be saturated.

As salts are more soluble in hot than in cold fluids, heat is said to increase the affinity between the solid & the fluid, for as this heat ^{by the saturated hot fluid} is lost, the solid is deposited, the force of cohesion overcoming the affinity. When a fluid is saturated with one substance, it may yet be able to dissolve another, thus when we saturate boiling water with nitre, it cannot dissolve any more of that salt, but is capable of dissolving a quantity of sulphate of soda. By decomposition an increased quantity of nitre may be dissolved. Solution is favoured by a number of circumstances, as—1. The quantity of the solvent. Solution of a certain quantity of a salt takes place much more rapidly when there is present an excess of the solvent, than when only a sufficient quantity for holding the salt in solution.

2d. Division. The more the solid body be ~~more~~ ^{divided}, the greater surface does it expose to the action of the solvent. If however it be in very fine powder, it has a tendency to form a mass with a portion of the fluid, which is with difficulty penetrated by the supernatant liquid, unless continually agitated.

3. Agitation. The stratum of water or fluid immediately in contact with the solid becomes

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saturated, it therefore cannot dissolve any more, its specific gravity is increased & therefore it remains at the bottom & prevents any fresh liquid from coming in contact with the solid, unless we use agitation, which by disposing the fluid already saturated through the entire ^{quantity} ~~mass~~, prevents any one portion ^{from} becoming saturated before another & thus favours the rapidity of the process.

4- Heat facilitates solution, of this I have spoken; but it is not an invariable rule as some substances as salt & litmus are as soluble ^{cold as in} boiling water, for salt the point of saturation is 90° .

5 Pressure is also to be mentioned as a means of promoting solution. Kane states that it is probable that it acts merely by raising the boiling point of the fluid & thus allowing a greater heat to be applied. In this way the glutinous principle is extracted from bones, by means of a digester, which could not be dissolved out by the water at 212° under the common pressure. Solution may be considered under two heads. 1- where we operate upon a homogeneous solid entirely soluble in the medium. 2d where we act upon an aggregate of solid bodies, of which some are & others are not soluble in the fluid used & we are thus enabled to effect their separation. The principal uses of solutions will be treated of under

the head of preparations

Lotion is the operation which consists in depriving an insoluble body of heterogeneous matter interposed and adherent to it, by treating it with a vehicle which shall dissolve these out of it, water or alcohol may be used or others, - thus Sulphur of commerce when sublimed in order to form the flowers, at the same time generates a quantity of sulphurous acid which adheres to them, of this it is necessary to get rid by lotion, or washing.

Lixivation is analogous to lotion, it is the operation by which soluble saline substances are extracted by treating the matter containing them with water. In order to accomplish this the substances to be operated upon are placed in a vessel the bottom of which is covered with straw or wicker work, pouring the fluid upon it & when it is saturated withdrawing it from the bottom. This is done several times.

The fluid thus obtained holding in solution the saline substances, is the portion afterwards employed, as in the separation of Soda from barilla.

By maceration is meant the continuance of drugs in a fluid during a time more or less prolonged, in order to extract from them certain principles, it is performed at common temperatures. Maceration is employed under the following circumstances, 1st when

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it is designed to dissolve only some of the principles of the heterogeneous substance & to obtain a preparation free from other substances, which would dissolve if a higher temperature was employed & would impair its efficacy & render it less elegant as a medicinal agent.

2d. Where either the solid or the fluid would be injured or dissipated by exposure to heat. Thus the medicated vinegars & wines must be prepared by maceration & infusions which contain aromatic substances.

Maceration is sometimes employed as a preparation for other operations. If we wish to extract the medicinal principles of certain dense roots, or hard woods it is very useful previous to boiling them to let them macerate for some time. By this mode the water gradually penetrates through the substance, softens it and renders its cells & vessels easily permeable to the boiling water, so that the solution of its active principles becomes much more perfect & more easily effected. It is recommended to make use of soft water in performing maceration. The menstrua are water, alcohol, wine & vinegar, forming as many species of preparations.

Digestion is maceration at a temperature more elevated than that of the atmosphere. The action of the solvent is promoted by a gentle heat, it is conducted in a matraass, with a

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sand bath, or by exposure to the rays of the sun. Infusion is effected by pouring a hot liquid upon drugs, in coarse division & then allowing it to cool, agitating into refrigeration has been accomplished. In ^{the process of} infusion, the higher temperature of the liquid augments very much its solvent power, & thus we ^{can} dissolve substances which would not be extracted by simple maceration. This energetic action lasts but a short time, as the temperature of the fluid progressively decreasing, finally sinks to that of surrounding objects, hence infusion is applicable best to such matters as are easily permeable, as leaves, flowers, ^{& to} those the properties of which would be impaired by ebullition, as cloves, orange peel & some barks, but it is not so fitted for extracting the virtues of dense roots or woods, from its action being of so short duration, except as in the case of colombo, where we wish to avoid the solution of a principle which would be taken up by decoction & would injure the preparation. ^{It is}

The vessels in which infusions are made are generally stone or earthen ware. As it is an object in the preparation, to retain the heat as long as possible, polished metallic vessels, provided they be not acted upon by the infusion, would be most applicable. Glass is inappropriate as it is liable to break. It is necessary to take care that, the vessels should be

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well closed, to avoid the loss of the volatile principles, which are important to the preparation. Decoction In this operation the substance is acted upon at the boiling point of the solvent, generally during a few minutes only, the menstruum is water in all the officinal decoctions.

Immersion is an operation which is sometimes employed in order to soften a substance or alter its state, it is plunged for a few minutes in boiling water & then withdrawn. As for instance almonds, ^{which} are plunged into boiling water, to facilitate the separation of their envelopes. Lichen islandicus is first plunged in water for the purpose of removing the bitter principle, before it is boiled.

Expression. By aid of mechanical force, fluids contained in succulent bodies are extracted & this is called expression, the case of juicy plants may be instanced, sometimes it is made use of to force the water from spongy precipitates.

The instruments by means of which expression is performed, are of different kinds, according to the degree of force required to be exerted: in some instances as in the expression of the juice of grapes lemons &c. the pressure of the hand is sufficient. When the juices of herbs, as conium, belladonna, &c are to be obtained, a screw press is necessary. An instrument has been pro-

displacement

posed by Count Real for the more perfect ⁴⁸ex-
traction of those principles of vegetables, which
are soluble in water. He terms it a filter press.
It consists of a tin box, in which is contained
the vegetable matter, either cut into small pie-
ces, or in coarse powder, from the top of the box
ascends a perpendicular tube to the height of
50 or 60 feet, the communication of which with
the box may be cut off by means of a stop cock.
The bottom of the box is pierced with a num-
ber of very minute holes & under it is placed
a vessel to receive the liquid. The perpendic-
ular tube is filled with water, which pressing
upon the vegetable matter with all its weight,
penetrates it every where & goes out through the
perforated bottom highly charged with the solu-
ble principles, for the water, a column of mercury
may be substituted, which does not require
so high a tube, & pressing upon the water
answers the same purpose.

Romushan instead of making artificial
pressure above the vegetable substance, econ-
omizes the atmospheric pressure by forming a
vacuum below it. Authorities differ as to the
practical value of these instruments.*

Juices obtained from vegetables by means
of expression are of two kinds, the watery &
oily.

With regard to the preparation of watery ju-
ices of plants, as the quantity is very varied

being abundant in some & small in others, in some is mixed with mucilage, in others impacted in dense cellular structure, it follows that the rules for the expression of watery juices must differ according to their composition & quantity. The following rules are given by Ranc. —

1st. In general. If the plants are very succulent, it is sufficient to cleanse them, cut them in pieces & beat them in a mortar & then submit them to the press.

2d. If plants are but slightly succulent, or if they are mucilaginous, they may be beaten up with a little water; in the first instance the water serves to wash the vegetable fibres, and to dissolve the juice which it retains; in the second it dilutes the mucilage & facilitates the exit of the juice.

3 Some juices are improved by being kept for some time before expression; others as those of oranges & lemons, should be allowed to ferment, after having been expressed, the last named fruits should be peeled before being expressed, to prevent the admixture of their acid essential ^{oil} ^{vegetable}.

The composition of ^{vegetable} watery juices is very complex. Besides the principles on which the activity of the plant immediately depends, they not only contain salts, vegetable acids, — gum, & chlorophyll, but also sugar, albumen

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and other matters which tend to promote fermentation. On this account they are seldom used as they are obtained, they are purified sometimes by depositive, sometimes by filtration & occasionally clarificative, operations - of which I shall speak directly.

The oily juices of plants or as they are called the expressed oils, as they are more properly termed, form a numerous & important class of vegetable products, closely allied in some respects to the volatile or essential oils, but as to ^{many} characters the very opposites of them. Under the head of castor oil, olive oil &c I shall give all the particulars relating to them.

Clarification. By this operation, liquids are deprived of solid particles which are suspended in them & which disturb their transparency, rendering them cloudy. Several modes of proceeding are employed either separately or successively.

When a liquid becomes clear of its self, upon being allowed to stand until the heavier particles subside to the bottom of the vessel in which it is contained, it is termed deposition, but it rarely happens that a liquid can be rendered sufficiently clear by this means consequently this step is but a preliminary one, in order to render another of more easy execution. When the dregs have subsided in the way mentioned, the clear

liquid is poured off, & this is called decantation. There are several ways of performing decantation, if the vessel be raised so as to allow an escape of its contents, there is risk that the deposit at the bottom will be disturbed, hence other plans have been adopted, leaving holes at various distances in the sides of the vessel in which tubes may be placed, or what is much better the use of the siphon; which is a bent tube from which the air has been exhausted. There are of various forms.

When a fluid at the ordinary temperature is too thick to allow the impurities to settle this may be accomplished, by raising its temperature & thus rendering it more fluid by diminishing its viscosity, when the heavier particles will descend to the bottom, while such as are rendered lighter will ascend to the top & can be removed. Honey is in this way clarified the dirt subsiding & the wax floating.

The most common clarifying agent however is albumen, which is soluble in cold water but becomes solid on the heat being raised to about 160°F . & after that, is insoluble in water. This is termed Coagulation. The substances used are white of egg, beaten with water, Milk, or Sethyocalla. When they commence to become solid after having been thrown into the fluid to be clarified, the impure particles

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suspended in the liquid are enveloped in the coagulum & subside with it.

Very often the liquid contains naturally a sufficient quantity of albumen to effect its own coagulation on applying heat, ~~from its~~ existing already ^{in vegetables} formed, it is called vegetable albumen &

When gelatine is used coagulation takes place from the union of this principle with the coloring matter of the fluid, containing tannin, it is generally used to clarify wines. Milk may be used upon the same principle.

Some liquids are turbid from the presence of vegetable or animal albumen, or sometimes gluten or caseous matter. These may ^{form} insoluble compounds with acids, hence it is only requisite, in order to clear them to add a small quantity of acid. Some juices of herbs are treated in this way. Alcohol is also employed at times. When these ^{agents} ~~substances~~ are employed, great caution should be used as to the quantity, as an excess of them would injure the properties of the product.

A mode of clarification frequently employed by the continental pharmacutists, is by fermentation. This process does not simply separate the impurities from the liquid mechanically, as the former methods, but it restores the limpidity of the fluid, by decomposing & destroying them; so, the vegetable juices subjected

Volatile oils & water,

to this mode of clarification, acquire by the ⁵ Process physical & chemical properties quite different from those which they before possessed.

Fluids can be separated from fluids only when there exists between them no disposition to combine, & when they are of different specific gravities, so that on being allowed to rest, the heavier of the two will sink to the bottom of the vessel & the lighter remain upon the surface, they may then be easily separated.

Decumation is the ~~operation~~ ^{process} by which substances which float upon the surface of a liquid are separated. It is done by means of a ladle or large spoon. In the case of heavier & lighter fluids, this may be practised. There is also another method, which is by imbibing a filter with the heavier of the two fluids, & then pouring the whole mass into it, an easy passage is afforded to that with which its pores are already filled, but remains impervious to the other.

Very often, the solid particles differ so little in specific gravity from the fluid, as not to admit of their separation by deposition. In this case we have recourse to Filtration and the apparatus used is termed a filter. Filters are made of a variety of substances. they should possess several requisites. 1st they should be wholly unacted on by the fluid to be passed through it; they should be totally devoid of qualities which

*Castor. oil & oxymels are also filtered in this-
way
† In this manner are strained melted fat, plas-
ter, resins, & wax.

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can be communicated to the fluid, & they should possess sufficient firmness to enable them to resist the pressure made upon them after being moistened by the fluid.

Woolen, ~~linen~~ ^{linen} or cotton cloths, paper glass & charcoal are used for filters.

Flannel filters are more usually employed to separate syrups & expressed vegetable juices. They are made of square pieces of flannel stretched upon a hoop, or attached by the four corners to a wooden frame. Generally the first portions of liquid which pass through are turbid, and require to be poured back, but as the fibres of the cloth swell by imbibing the fluid, the diameter of the pores diminishes & the fluid passes nearly clear.*

~~Linen~~ ^{linen} filters are used to ~~collect~~ ^{for} basic salts which would act upon flannel, they are used in the same way. Either this material or cotton is employed when the ^{fluid} substance is too viscid to pass through paper, & conical bags made of them are most readily manipulated with, as for instance in straining Mucilage, as flaxseed ted. Sassafras pith &c.†

But the most convenient ~~substance~~ ^{material} for a filter is unsized paper, called filtering paper, — where the object is to separate a fluid from a material insoluble in it, the quantity of which does not require to be determined, this paper answers all purposes, as in filtering —

tinctures wines, saline solutions, watery infusions & essential oils. but where it is necessary to determine the amount of the substance, it is inappropriate, from its retention of so much of the substance. Under these circumstances the tissue paper answers a good purpose, as it does not allow any of the solid substance to penetrate its texture & its surface is so smooth, that when dry it allows it to be collected ~~from~~ ~~it~~ with the smallest possible loss. In order to increase the strength of paper filters, two may be used conjointly, this is peculiarly applicable to the tissue paper filter, besides, in the fineness of its pores, is found the reason for the delay in the operations.

Paper filters are of two sorts the plain & the folded, the first is made by simply folding the paper twice in opposite directions, so as to bring the four corners together & then opening one of the corners. this filter is easily formed but has two disadvantages. Its surface being smooth, adheres in every place to the funnel & one side being three times as thick as the other, its strength is very unequal.

The folded filter obviates these disadvantages. It is formed in the following manner, the paper is first doubled & then again folded into halves, these into quarters & these again into eighths. The folds being all upon the same side, each eighth is now to be folded into sixteenths, in the oppo-

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site direction, but the folds all radiating from the centre to the circumference, the doubled piece then resembles a child's fan, & when opened & the corners cut off, it will be found, that the paper is equally divided into parts, forming alternate external & internal angles, except where two external angles meet at opposite sides. This filter presents a larger extent of surface & consequently the operation is quickened.

Concentrated acids are generally filtered through powdered glass, or quartzose sand. A fragment of glass is first dropped into the tube of the funnel & over it several smaller pieces; ~~are~~ ^{then} cover them with successive layers of the same material, more & more finely divided, until the upper surface is composed of a nearly impalpable powder. The filter thus prepared is then washed with diluted muriatic acid to remove all adherent particles of earthy matter, & ~~then~~ ^{of the acid} the last traces, are washed away by distilled water. On the filter thus prepared the acid to be filtered is poured which oozing through the glass deposits its impurities & flows clear from the bottom of the funnel. Sand may be substituted for the powdered glass.

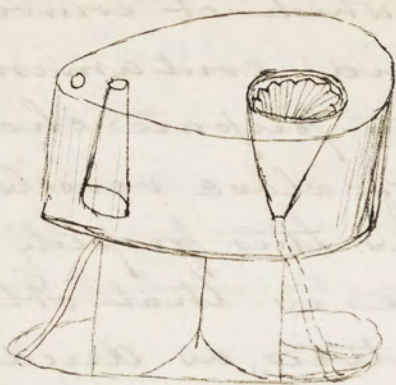
Charcoal filters are very frequently employed, - they appear to do more than produce a mechanical operation upon the fluid passed through them, there seems to be a chemical agency exerted upon the colouring & other matters

into a structure, but the whole all existing
from this center to the circumference, the
hatched piece that resembles a chain part
between spaces of the common cut off, it will
be found that the paper is equally changed
into parts forming alternate columns & water-
and paper, except when the external surface
is not of opposite sides, the latter presents a
large extent of surface & consequently the
operation is quickened.
In recent cases which are generally lighter than
others, a glass or quartz vessel is used, it is important
that the vessel should not be too large, the funnel
over it should be small, the water being the same as in the
process, upon the same material, the same
kind of changes, that the upper surface is exposed
to nearly impenetrable water, the latter then
is not so thick, but that the water penetrates
into the center all adjacent particles of water
matter, & thus the last traces are washed away.
In distilled water, in the latter case, the
the acid to the solution is present which is
found in the glass deposited at the bottom of the
funnel, the bottom of the funnel is not very
is substituted in the second case glass.
General notes are very frequently employed,
the effect of the water that produces a new
chemical operation upon the fluid formed
though they seem to be a chemical operation
on water, the coloring & other matters

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contained in the fluid, with which it combines & separates them from the fluid contaminated by their presence. In order to prepare charcoal it is necessary make use of close vessels. But the charcoal from wood has this property in a feeble degree. The most active is that obtained by carbonizing animal matter, as dried blood, hair hoops, ~~bones~~ &c with carbonate of potassa, which prevents its fusion & gives the greatest possible degree of mechanical division to the resulting charcoal. The carbonate is washed away by water. That which is produced by burning bones is called ivory black, in this case the phosphate of lime effects the minute division of the charcoal. The carbon is here however ~~combined~~ ^{mixed} with a quantity of inert saline matter, which cannot be removed by water & if diluted muriatic acid be used, the decolorizing power of the product is considerably impaired.

It has not as yet been perfectly determined, what colouring matters are & what are not destroyed by animal charcoal. As far as is at present known, it appears to act merely upon compounds of organic origin, such as the colouring matters of cochineal, litmus, logwood & indigo dissolved in sulphuric acid, the colouring matter of red wine, of unrefined sugar, the fetid effluvia of putrefying matter & many volatile & empyreumatic oils.



Flower filter.

Much inconvenience is often experienced in the filtration of hot saturated saline solutions, by the cooling of the liquid & consequent crystallization of the salt, in the neck of the funnel & filter. To obviate this an apparatus has been invented by Prof. Hare, for a description of which I must refer you to the U.S. Dispensatory.

Many fluids would be injured by exposure to the air, & caution is necessary to obviate such results. Some of these by imbibing carbonic acid, as. potassa, baryta & lime. Others being volatile a loss would be sustained. Covered filters are under these circumstances to be employed.

Lecture IV

Evaporation is a ^{process} ~~operation~~, in which a liquid exposed in the open air to the action of an elevated temperature, is driven off in the form of vapour, while the solid parts with which it is imbedded, are concentrated ^{reduced} into a diminished volume. In this way are formed the Extracts & Inspissated juices. This operation differs from ^{vapor-} ~~eva-~~ ization, in as much as it is conducted by aid of the atmosphere while the latter is produced by heat alone, & in the one case it is the solid matters which are important, while in the other, the vapours are collected condensed & preserved.

Evaporation ~~requires consideration~~ ^{should be considered} under two points of view, 1st the principles on which the operation is founded, and the phenomena which accompany it & 2dly the Mode of obtaining the pharmaceutical products.

The rapidity of evaporation depends upon two circumstances, the temperature & the pressure, at common temperatures, most fluids & some solids are gradually converted into vapour, ^{they are} ~~they are~~ termed spontaneous evaporation, and they disappear more rapidly, as their boiling point is lower, thus ether evaporates more quickly than water.

Fluids evaporate more rapidly in vacuo, because as their boiling point is considerably reduced by the removal of the

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atmospheric pressure, they have as great a tendency to evaporate at common temperatures in vacuo, as if they had been heated in the open air, until the temperature held the same relative to the boiling-point. Thus water at 85° (boils in vacuo, at 50° ; therefore, it would have as great a tendency to evaporate, as it would were it heated to about 170° under the common pressure of the atmosphere."

"Most fluids, & many solids also, as carbonic sublimates, chloride of antimony - &c. throw off considerable quantities of vapour at common temperatures, this spontaneous evaporation was formerly explained, by saying that the air, having an affinity for these substances, dissolved them & kept them in solution by a sort of chemical affinity. This view agreed very well with many phenomena (as the chemical view of solutions in general agrees with many phenomena) thus the solvent power of the air was augmented by heat and diminished by cold, & the evaporation of the fluid was increased in rapidity by a current of air, the quantity of the solvent being then so much greater. But this view otherwise so plausible, was soon overturned by De Senne, who discovered that the presence of air was absolutely an obstacle to evaporation, & that that process went on with

infinitely greater energy in vacuo when no-
air is present. The following is the explanation.

All fluids have within certain limits of temper-
ature, a tendency to convert themselves into
vapour, and the vapour, when once formed,
diffuses itself through the air as one gas does
through another, according to the law of Dalton.
At a certain temperature, the particles of the
air are at a certain distance from each
other & are capable of allowing a certain
number of particles of water to penetrate
between them, when these spaces are filled
up, the air is saturated with water at that
temperature; if the heat be increased, it be-
comes capable of holding more; if its tempera-
ture be diminished, it deposits some of the
vapour by which it had already been pene-
trated. As the quantity of superincumbent
vapour increases, the pressure upon the remain-
ing fluid augments, and at last reaches
a point where evaporation at that temper-
ature ceases. A current of air promotes evap-
oration, therefore not by presenting new quan-
tities of a solvent to the ~~surface~~ ^{fluid}, but by remo-
ving the particles of vapour as they are formed,
and thus preventing any considerable augmen-
tation of pressure.

The extent of surface ^{area} present some consider-
able difference, in the rapidity of evapora-
tion, for as this operation takes place from

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the surface alone, it is greater or less in proportion to the extent of this surface.

Spontaneous evaporation is used in the chemical arts for many purposes, as the obtaining of sea salt from sea water & in pharmacy it is not usually employed, although Languier, & Chevallier state that many distilled waters, as that of tobacco for example, which yield no solid substance when evaporated by heat, leave behind, when given up to spontaneous evaporation, a peculiar greenish extractive matter, probably possessing active properties.

Evaporation in the open air is generally expedited by applying heat, the mode of effecting this purpose varies with the nature of the substance upon which we operate.

In evaporating solutions of salts or other substances not destructible by heat, the process may be accomplished either with a naked fire or on the sand bath, taking care not to produce such violent ebullition as would endanger the ejection of any of the liquid from the vessel. A few circumstances only require notice in such a case; in evaporating concentrated saline solutions, on reaching a certain point, the salt begins to be deposited on the sides of the vessel; if the salt be anhydrous, its particles gradually form a cake, between which & the inside of the basin, steam is formed, which being for a time

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confined, at last forces its way out with a force sufficient to cause the dispersion of a great quantity of the material & often the breaking of the vessel. This is easily avoided by stirring the mass & thus preventing the adherence of the deposited salt to the bottom of the basin.

When the substance to be obtained by evaporation is of organic origin, it is necessary to avoid the application of so high a heat & to be extremely cautious in its management.

When the solution is dilute, the process may be commenced on the sand bath, taking care not to immerse the vessel too deep in it. & to place under the basin a slip of card or a wood shaving, by the occasional inspection of which, it can be easily known whether the heat applied be sufficient to endanger the decomposition of the vegetable matter. When once the liquid begins to thicken, it should be immediately removed from the sand bath & the evaporation effected either through the medium of vapour or water; indeed where great care is required, the process should be terminated by the gentle heat of a stove, or of the water bath at a reduced temperature.

The vessels in which evaporation is carried on are capsules, pans, or shallow dishes of various sizes & of different materials, accor-

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ding to the nature of the substance to be operated upon.

Steam is sometimes employed as a heating-agent, applicable to the purposes of evaporation, it is made to act by keeping the vessels in which are contained the fluids to be evaporated, in contact with it, by which a temperature near to that of the boiling point of water is preserved. Several apparatus have been invented for this purpose.

Crystallization. When during the gradual transition from the fluid to the solid form the particles of a body assume certain regular forms, these forms are termed crystals - & the phenomena of their production, crystallization. I shall not enter into an examination of the forms of crystals or their peculiarities, all that I intend, is to treat of the operation of crystallization as it appertains to Pharmacy. There are different modes of forming crystals that most usually employed - is by solution, & concentration by heat, but they may be formed by sublimation & fusion. Volatile substances are crystallized by sublimation, as sulphur, Benzoin &c. Metals are crystallized by fusion.

Substances are crystallized by solution in 3-different ways.

1- by operating upon them in solution, at the boiling point of the fluid. & with such

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an excess of the soluble body, that the fluid dissolves more than it can retain when cooled, which is deposited upon cooling.

2. By evaporating by the aid of heat, the liquids which are not so charged with the substance as to furnish crystals in the cold state, or which have deposited by cooling — all that they are capable of depositing, and they must be concentrated anew.

3d. By allowing the liquids to evaporate spontaneously, & this last gives as a result the most beautiful crystals, as it is conducted with least agitation & very slowly.

It is not absolutely necessary that bodies should possess the fluid form to pass from ^{an} amorphous to a crystalline state, as for instance barley sugar.

Various menstrua are employed in the operation of crystallization, as water, Alcohol, & ether. which are all best fitted for various substances, and suit the purposes for which they are used, of this we shall have abundant illustration when treating of the several proximate elements of substances.

It is easy to determine if a solution of a substance will yield crystals, by allowing a drop to fall on a piece of glass, when if this phenomenon can take place, crystals will be deposited.

Crystallization is much promoted by agita-

tion, but the crystals produced are small, as is the case with Epsom salt.

When speaking of crystallization, it is not inappropriate to the occasion, to notice the manner in which crystals are purified, & this is done by washing them. "Water which is saturated with any salt is still capable of dissolving other salts. It is in this way, by washing crystals of impure salts with their own saturated solutions, that the crystals are purified. Fine silky crystals which retain their mother water by capillary attraction must be dried by strong expression in a linen bag. The finest silky crystals may be entirely freed from their adhering liquid by placing them in a funnel which fits closely to one of the necks of a double mouthed bottle, and fitting a tube to the other, through which air is drawn. The current of air in passing through the funnel, carries the water with it, & dries the crystals perfectly.

For further particulars with respect to crystals & crystallization, & for the meaning of the terms deliquesce, effloresce, precipitation &c I must refer you to my colleague.

Congelation or Solidification. This is the operation in which a body passes from the liquid to the solid state, by losing its caloric. Between these two terms, there is this distinction, that Congelation is opposed to the reverse

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of liquifaction, while solidification is opposed to fusion, thus wax & fatty substances after being liquified become congealed, metals after fusion become solid.

Congelation by exposure to cold is sometimes employed to concentrate solutions, thus by freezing vinegar, the water alone is converted into ice which can be removed in the solid state, while the remaining fluid is saturated with the acetic acid, so also with seawater. Fatty substances may be separated into their two parts stearine & oleine in the same manner, as the former at a certain temperature becomes solid.

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The above is a list of the
specimens, their size & fatty substance after
being dissolved in ether. Most of the
specimens become solid.
The material by exposure to cold in a vacuum
is changed to a crystalline substance, the
specimens, the water which is removed
with the liquid can be removed in the solid
state, while the remaining fluid is removed
with the acetone used, so also with the
water. The fatty substance may be separated
from the parts of the specimen & placed in a
the same manner as the former at a low
temperature (become solid).

— Mixture —

Mixture is that species of preparation, which produces a union more or less intimate between the particles of different bodies.

But it is necessary to observe that this union should not become so intimate as to destroy the respective properties of bodies, for in this case it would be combination.

Fluids are mixed by agitation in a vessel into which several kinds may be placed.

Dry powders are frequently mixed together to form compound powders, this is effected by first triturating them together & then passing the mixed mass through a fine sieve.

Soft substances are beaten together in a mortar or with a spatula.

Combinations
— Chemical Action —

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Chemical action is that which affects the elementary component molecules of bodies, by combining them with others, or by isolating them when they are combined, giving to them entirely new properties.

This involves the physical & sensible attributes of bodies, which are changed by chemical action, thus those which were heavy may be made lighter, those which possessed one form or colour may be made to assume others, at the same time that chemical habitudes may be entirely altered, thus lime which is corrosive may be made mild & inactive by combination with carbonic acid, & the reverse. This chemical action extends not only to simple bodies but also to compound bodies, and may be stated to constitute the play of chemical affinities, the laws of which are displayed in the various operations which come under the head of chemical action, leading to composition or decomposition.

Chemical action is employed in a great number of pharmaceutical operations. Some of these alone have received special names, which rather indicate effects than operations — thus, we see mercury dissolved by nitric acid, an extrication of gas ensues, which is termed effervescence, & the nitrate of mercury is thrown down, which is termed precipitation, now

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these terms give us little information of the processes which take place, or the causes of them did we not know how the laws of combination operated & the nature of the substances upon which we operate. I shall present an explanation of what is meant further by these terms—

Dissolution of a body, is an operation, or rather an effect, which takes place in consequence of the reciprocal action ^{between} of a liquid and solid, the latter disappearing, by which a compound liquid is formed, having properties new & different from either the liquid or solid, as for instance the dissolution of the metals by acids. This must not be confounded with solution of which we have previously spoken, where the chemical properties of bodies are unaltered.

Precipitation is an effect produced, when a body, dissolved in a liquid, becomes insoluble by the addition of an other body, or the subtraction of a part of it if it be compound, & in consequence of its specific gravity it falls to the bottom of the vessel. There are two kinds of precipitation, one takes place when the body precipitated exists in the solution, as in the instance of Remes Mineral, when the solution is cooled, or the ammoniacal solutions of metals, which are precipitated when the ammonia is driven off. The other species of precipita-

tion exists, when the precipitated body does not exist in the solution but is formed in consequence of the union of two or more bodies brought together in solution, as for instance, the chloride of silver, formed by precipitating nitrate of silver by means of hydrochloric acid, & in the cases of all double-decompositions.

Effervescence. This is the agitation produced in a liquid, by the extrication of a gaseous fluid contained in it, it resembles the effect of heat carried to the boiling point in a liquid. It depends upon a number of causes, 1- from diminution of pressure, a fluid is capable of containing a greater quantity of a gaseous fluid, when a high pressure is made upon it, that it would otherwise do, the common mineral water fountain is illustrative of this fact. & also the sparkling-wines, in many liquids when the ordinary pressure of the atmosphere is removed, effervescence follows as a result, which will be demonstrated by the Prof. of Chemistry.

2-d. By the action of two substances in solution upon each other, one of which contains an aeriform fluid, as for instance tartaric acid or carbonate of potassa, or where one is fluid & the other solid as sulphuric acid & the carbonate of potassa, of this result you will have numerous examples in the course of the chemical lectures.

Carbonization. —

By this operation bodies which are exposed to heat & excluded from the air are converted into carbon or charcoal, they may be either of animal or vegetable origin. These substances are composed of oxygen hydrogen & carbon, & in the former case of azote. Now the heat decomposes them & separates the gaseous elements, which are dissipated either singly or under new forms leaving the solid residual charcoal, which is in the largest proportion⁺ which contains usually some other fixed substances, most generally salts or alkalis. The substances which are thus charred are wood, bones, hoofs, horns ivory & sponge. The latter contains iodine.

Incineration. In this operation, the substances are exposed to heat in the open air, & combustion takes place with its phenomena. Bodies are incinerated with the view to obtain such portions of them as are not combustible, and the residuum is termed the ash, which is of an earthy nature finely divided, in this way the alkalis are obtained, which may be separated by solution. Upon the large scale it is accomplished in pits, on a small scale, for pharmaceutical purposes iron vessels are employed, or crucibles of various kinds. Sometimes reverberatory furnaces are employed.

Calcination is incineration when mineral bodies are to be operated upon, as in the

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instance of lime. & it has for its object the separation of some component principle which can be driven off by heat, as carbonic acid or water, as in the case of alum. An other object of calcination is to attract the oxygen of the atmosphere and form an oxide as in the case of the metals. There is a third which combines the two first, in which the volatile ^{constituent} principle of a body is driven off while that which remains is combined with oxygen, thus in roasting ores, if a sulphuret, the sulphur is disengaged & the metal remains as an oxide. but most commonly sulphur is driven off as sulphurous acid. —

Reduction, removes the oxygen from a metal with which it is combined after being smelted, for which purpose fluxes are used, of which carbon is the best.

Fermentation is an other chemical operation but it would encroach too much upon the duties of my colleague were I to enter into an account of it.

Lecture V Weights and Measures.

At the time of writing my Lectures I did not write out a Lecture on this subject but made my remarks from notes. I afterwards examined the subject in 1830 for the University class & framed a lecture but now in 1859, have resumed the subject and have made from various authors the following notes.

Report on weights & measures by John Quincy Adams Secretary of State of the United States 1821. Report of the Senate 1821. ^{P. B. Putnam} Philad^a
& France & England are the only Nations of modern Europe who have taken much interest in the organization of a new system, or attempted a reform for the avowed purpose of uniformity. The proceeding in those two countries have been numerous claborate and persevering & in France especially, comprehensive, profound, & systematic. In both the phenomenon is still exhibited, that after many centuries of study, of invention of laws, and of penalties, almost every village in the country is in the habitual use of different weights & measures. Which diversity is infinitely multiplied by the fact, that in each country, although the quantities of the weights and measures are thus different, their de-

Nominations are few in number & the same names, as foot, pound, ounce bushel, pint &c are applied in different places & often in the same place to quantities altogether diverse.

We derive our weights & measures from England - where from the earliest records of parliamentary history the statute books are filled with ineffectual attempts of the legislature to establish uniformity. Of the origin of their weights & measures the historical traces are faint and indistinct, but they have had from time immemorial the pound, ounce, foot, inch & mile, derived from the Romans & from them from the Greeks, & the yard, or girth a measure of Saxon origin derived like those of the Hebrews & the Greeks from the human body, but like theirs taken from the length or members but from the girth of the body. The yard of the Saxons evidently belongs to a primitive of measures different from that of the Greeks, of which the foot, & from that of the Hebrews, Egyptians & Antediluvians of which the cubit was the standard. It affords, therefore another demonstration, how invariably nature first points to the human body & its proportions, for the original standard of linear measure. But the yard being for all purposes of use a measure corresponding with the ulna or ell of the Roman system, became, when super added to it, a source of diversity, and an obstacle to uniformity.

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in the system, and this may perhaps be the cause of the difference of the present English foot. The yard therefore very soon after the Roman conquest, is said to have lost its original character of girth; to have been adjusted as a standard by the arm of King Henry the 1st & to have been found or made a multiple of the foot, thereby adjusting it to the remainder of the system; & this may perhaps be the cause of the ^{of the difference of} present English foot from that of the Romans, by whom as a measure it was introduced.

The ell measure has however in England retained its place as a measure standard for cloth, but in the ancient statutes, which for centuries after the conquest were enacted in the degenerate Latin of the Ages, the term ulna or elle, is always used to designate the yard. A full century, before the conquest Edgar prescribed the same weights & the same measures throughout the realm, but it was never adhered to.

The Norman conquest made no changes in any of the established weights & measures.

One of the principal objects of the Great Charter was the establishment of uniformity of weights & measures, (as they existed) and a uniformity of proportion not of identity. This was reenacted by Henry III. 1225 AD. confirmed by his son Edward I. In subsequent confirmations it has been supposed to have prescribed uniformity of identity, but this is not the case. As there were several weights

and Measure it was the object not to bring these to the same but to fix them as they existed. The words of Henry III are "There shall be one measure of wine through our realm & one measure of ale & one measure of corn, that is to say the quarter of London, & one breadth of ^{weaved} broad-cloth, that is to say two yards (elne) within the lists, and it shall be of weights as it is of measures."

~~That~~ ^{Do} have prescribed that there should be but one unit of weights & one measure of wine, ale & corn, would have been a great & violent innovation upon the existing habits & usages of the people. The chapter is not intended for a general regulation of weights & measures. It refers specifically and exclusively to the measures of three articles, wine ale & corn & to the width of cloth. Its extension was to provide that the measure of corn ale & wine, should not be the same, that is that the wine measure should not be the ^{broad} same for ale or corn nor the ale measure for wine.

The English penny was regulated at 32 grs of ^{wheat} ~~lead~~. So by this regulation, "That an English penny, called a sterling pound & without any clipping, shall weigh thirty two wheat corns in the midst of the ear, & twenty pence do make an ounce & twelve ounces the pound, & eight pounds do make a gallon of wine & eight gallons of wine do make a London bucket, which is the eighth part of a quarter" 1266 AD 51 H. III.
Henry III was the seventh King of the

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Norman race & this statute was passed exactly 200 years after the Norman conquest. It is merely an exemplification word for word of the ordinances of his progenitors Kings of England, and it unfolds a system of uniformity for weights, coins & measures of capacity very ingeniously imagined & skillfully combined.

Originally the penny was the 240th part of the tower pound: the sterling or eastling pound which had been used at the first for centuries before the conquest & continued to be used until Henry vij 1527 - when the troy pound was substituted for it.

The tower pound weighed $\frac{3}{4}$ of an ounce troy less than the troy pound, & was consequently in the proportion of 15 to 16 - Its penny or 240 part therefore weighed $22\frac{1}{2}$ grs troy (or 32 grs wheat) which according to the statute of 1266 had been taken to form the standard measure of wheat for the whole realm of England. It is also to be remembered that the eight twelve ounce pounds of wheat, which made the gallon of wine produced a measure which contained nearly ten ^{of the same} pounds of wine, the commercial pound, by which wine & most other articles were weighed, was then 13 ounces. This is apparent from the treatise of weights & measures of 1304 - Ed I. which repeats the composition of measures declared in the statute of 1266.

After making many specifications, it goes on to say, "it is to be known that every pound of money & of medicines consists only of twenty

shillings weight, but the pound of all other things consists of twenty five shillings. The ounce of medicine consists of twenty pence & the pound contains twelve ounces, but in all other things, the pound contains fifteen ounces & in both cases the ounce is of the weight of twenty pence.

We are enabled from the data to ascertain accurately the dimensions & contents of the bushel, the ale gallon & wine gallon of 1266. The silver penny called the sterling, to which 32 kernels of wheat were equi-ponderant was equal to 22½ grs troy. Its pound of 12 oz was equal out to 54 ~~po~~ grs troy. The pound of 15 oz by which wheat & wine were weighed was equal to 8750. grs troy. Eight pounds were equal to 34000 grs troy which divided by 250 the No of grs troy, weighed by a cubic inch of Bordeaux wine, gives a gallon of 216 cubic inches.

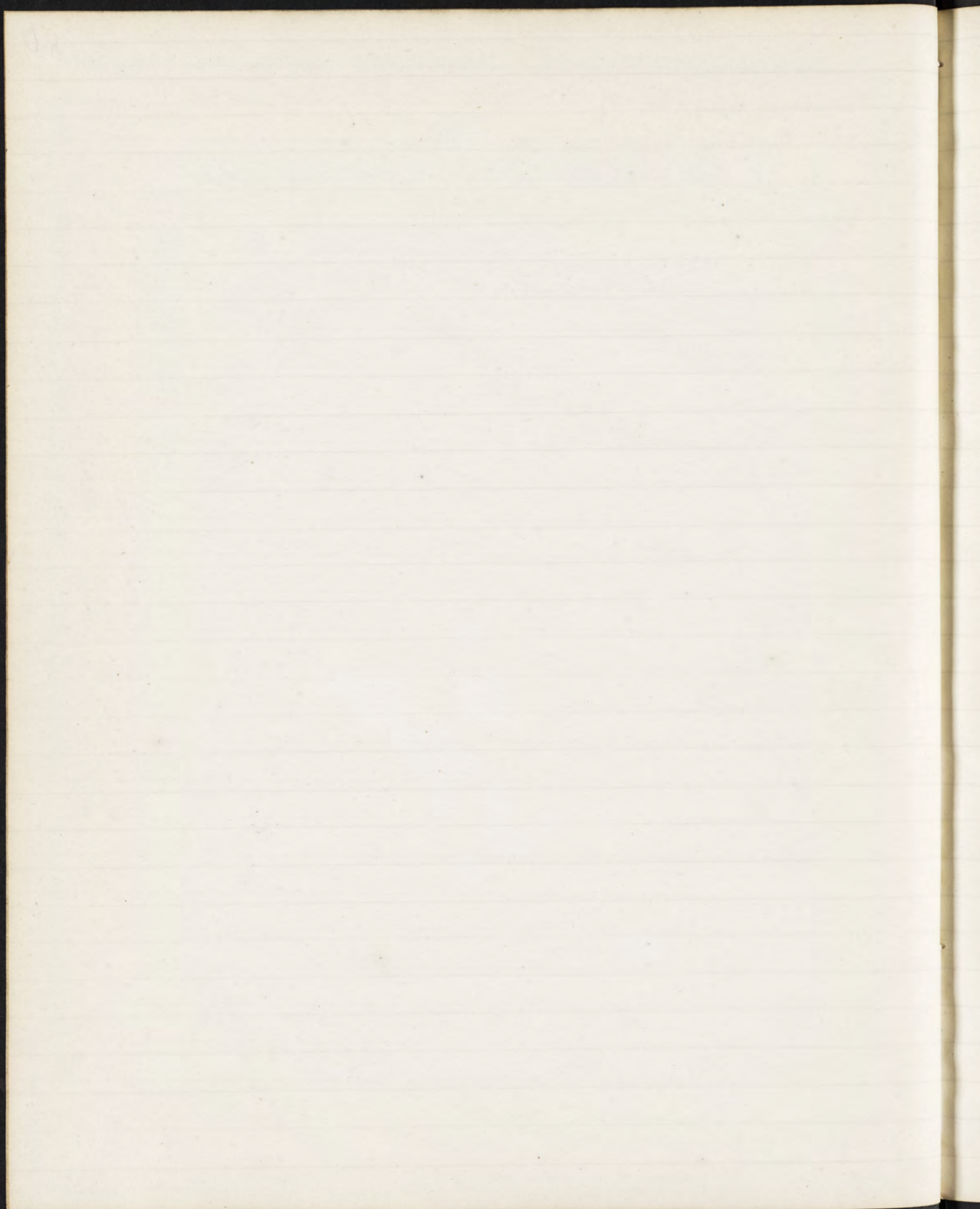
There is no standard of wine measure of that age extant in England, but in 1493. All the then existing statutes were made applicable to Ireland. (Henry VII 1493.) The changes subsequently made in England have not extended to Ireland in relation to wine. & the standard Irish measure of wine is 217.6 cubic inches. Which forms the little difference from the law of 1266. Must have been referrible to this fact.

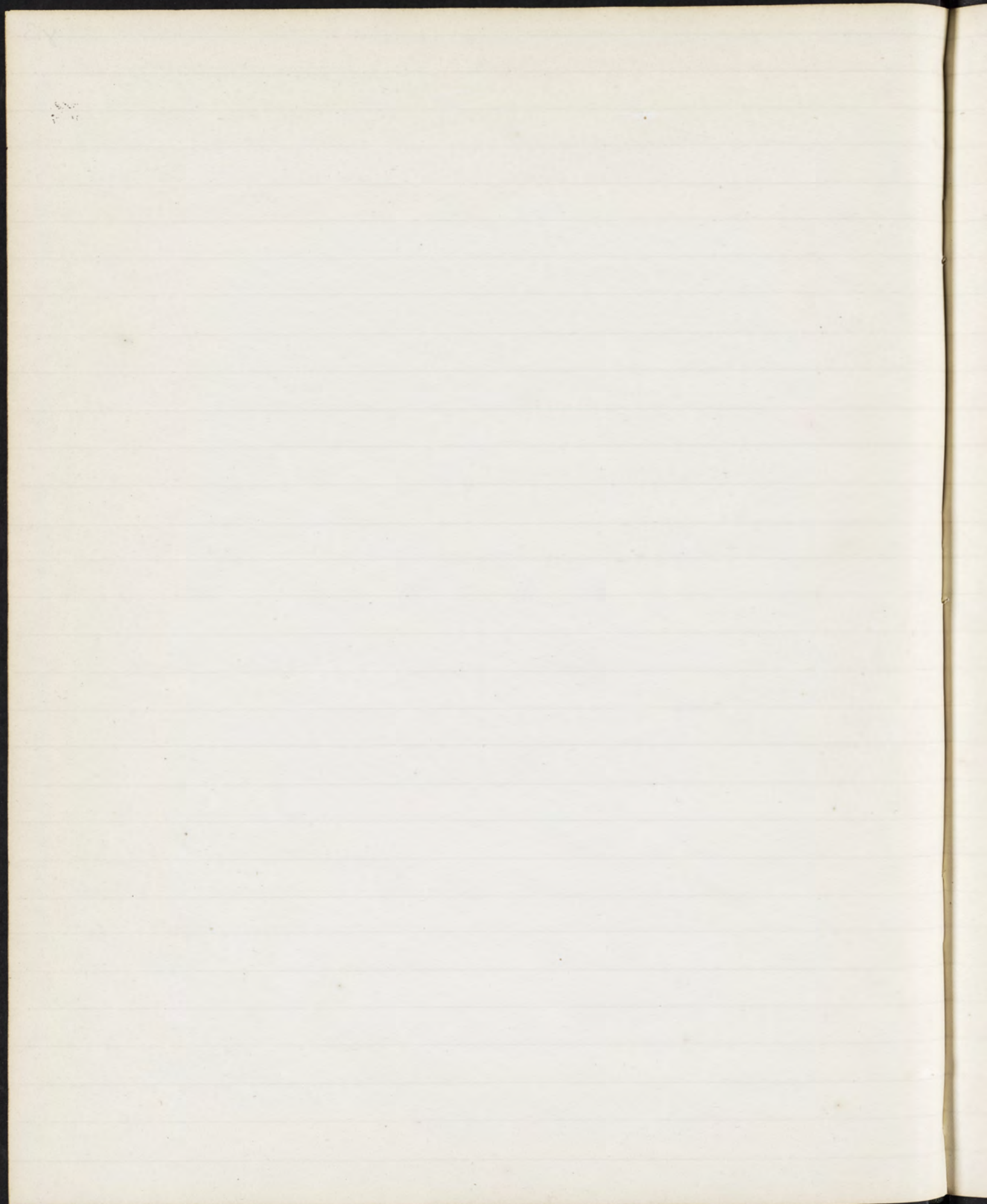
This system of weights & measures has been, by many of modern English writers on the subject supposed to have been established by the statute of 1266. But it is a mere exemplification

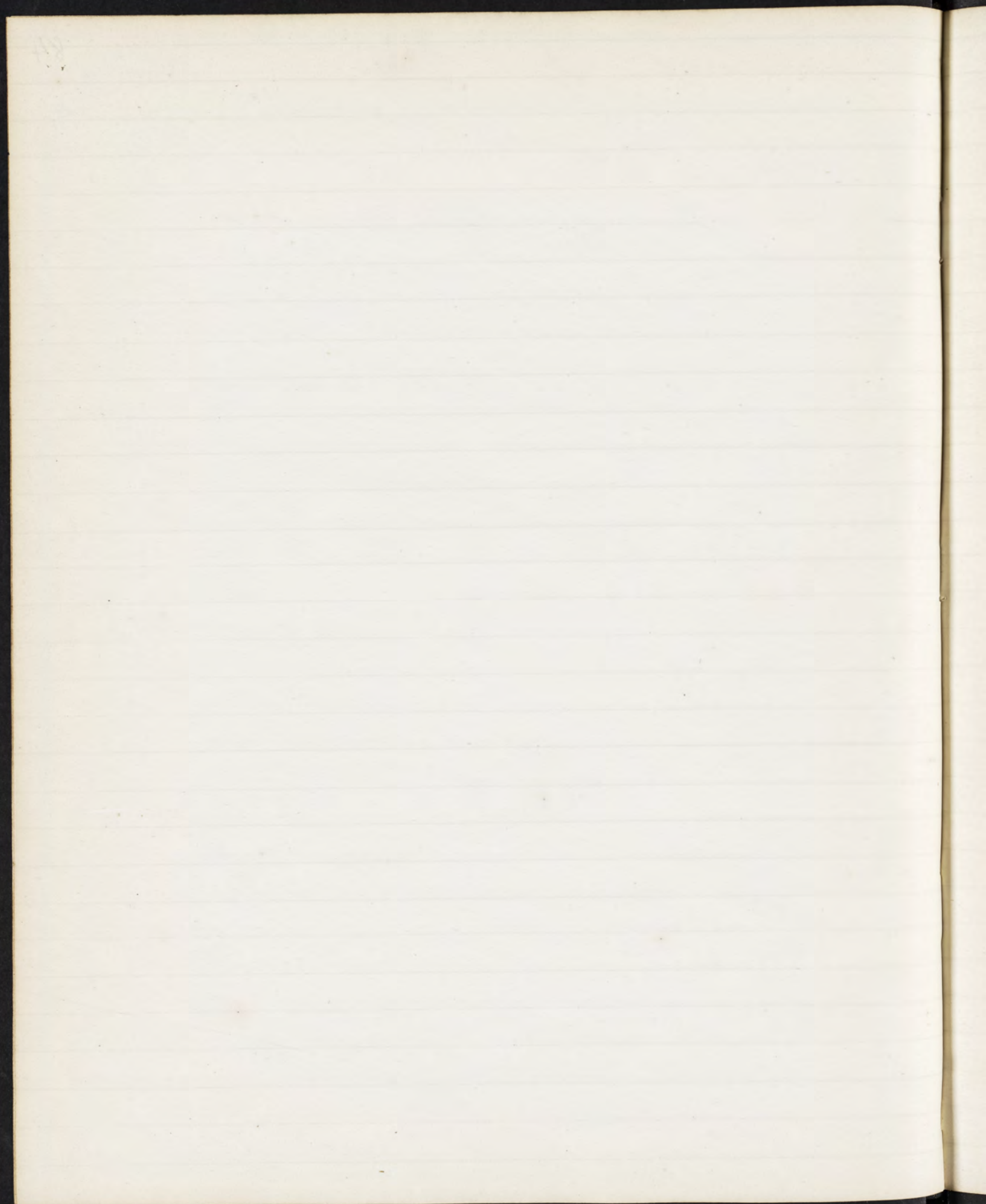
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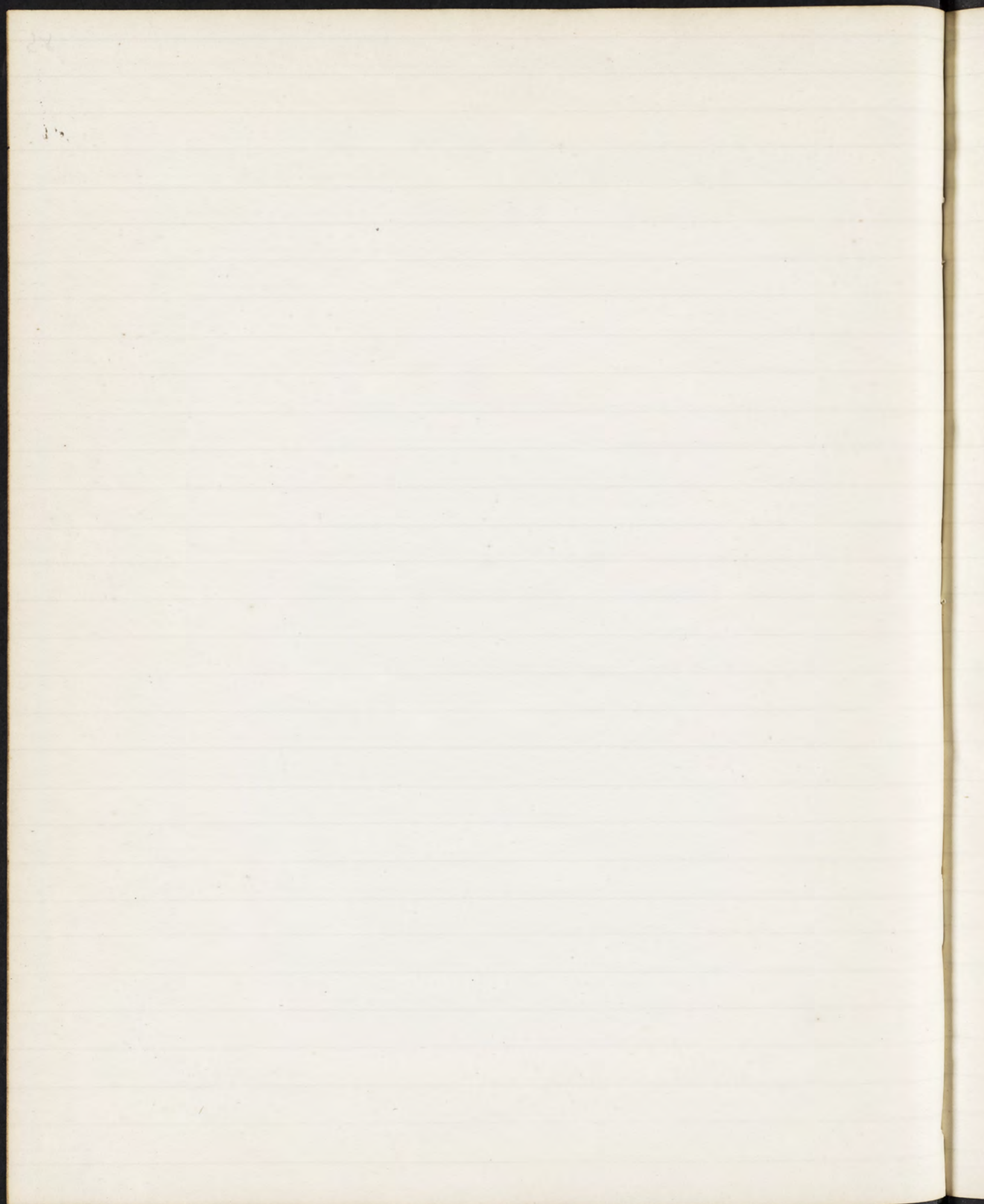
cation of ancient ordinances. The considerations
in its composition with those of the ancient Ro-
mans, proved by the letter of the Silian law, & by
the still existing coins of Vespasian, with those
of the Greeks as described by Galen & as shown
by the proportions between their scale weight & their
metrical weight, & with that of the Hebrews as
described in the prophecy of Ezekiel, show that
their origin is traceable to Egypt and Babylon &
there vanishes in the darkness of antiquity.

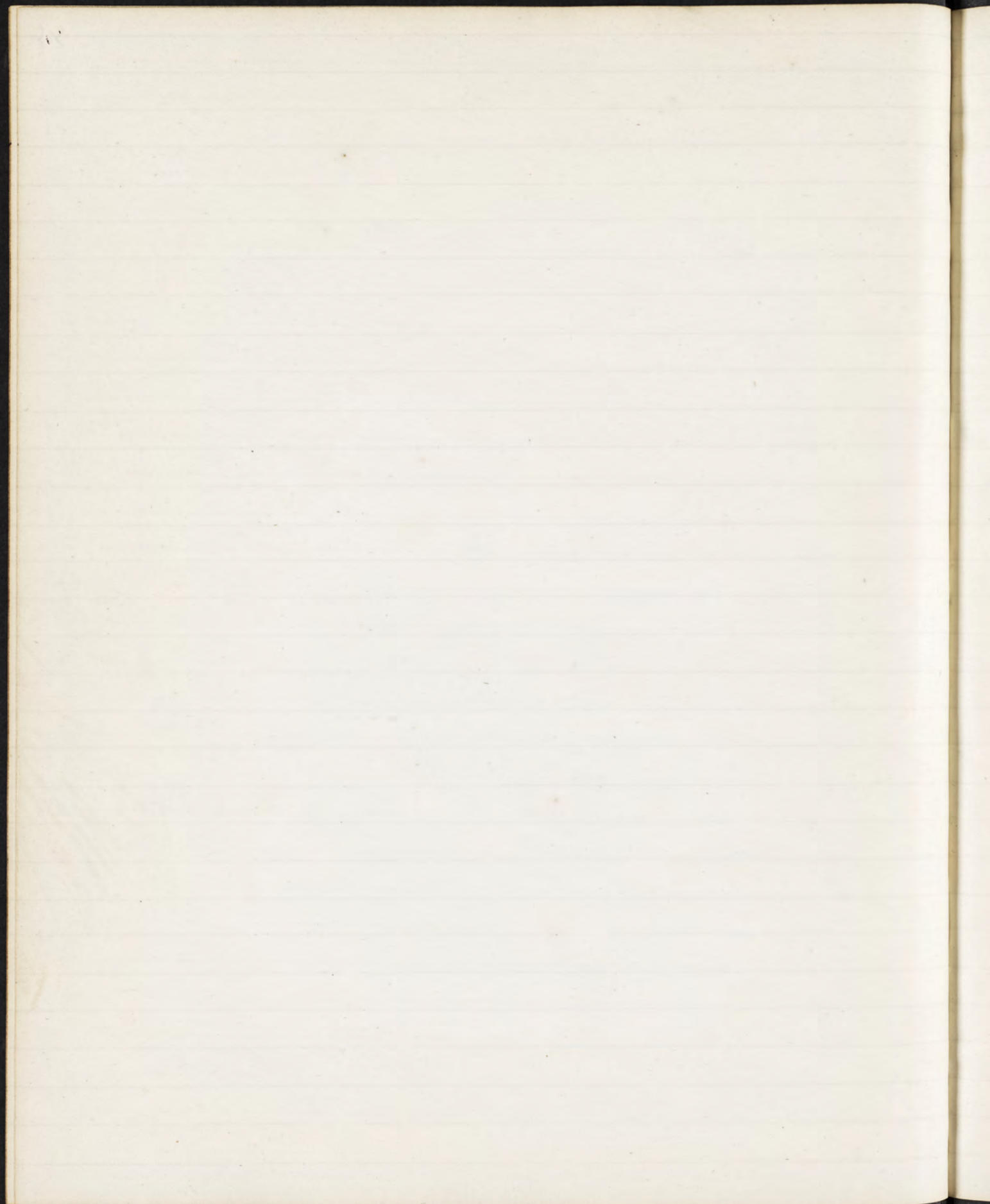
As founded upon the identity of Mummery-
weights & silver coins & upon the relative proportion
between the gravity and extension of the first
articles of human traffic, corn and wine, it is
supposed to have originated in the nature
and relations of social man & of things.

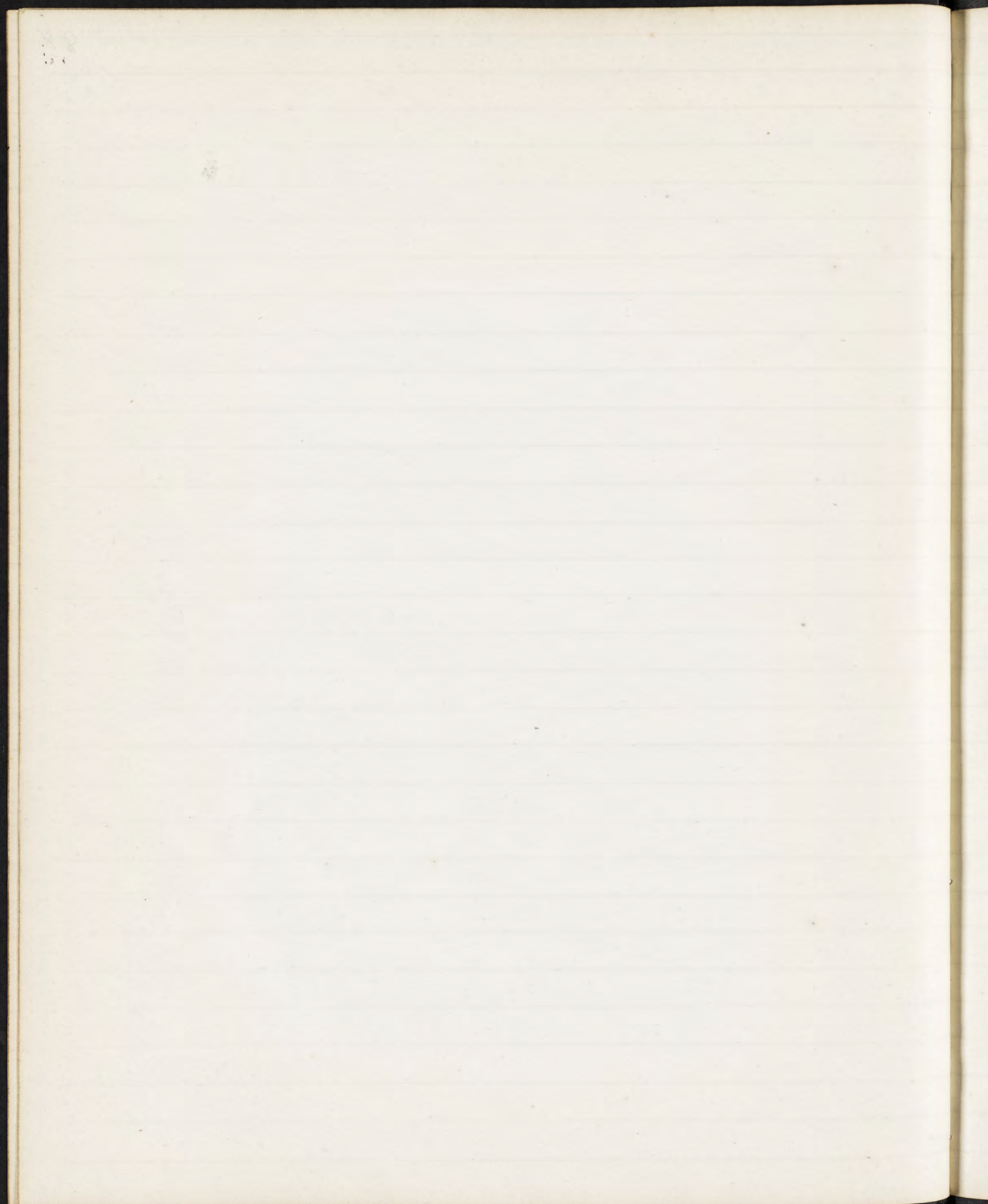


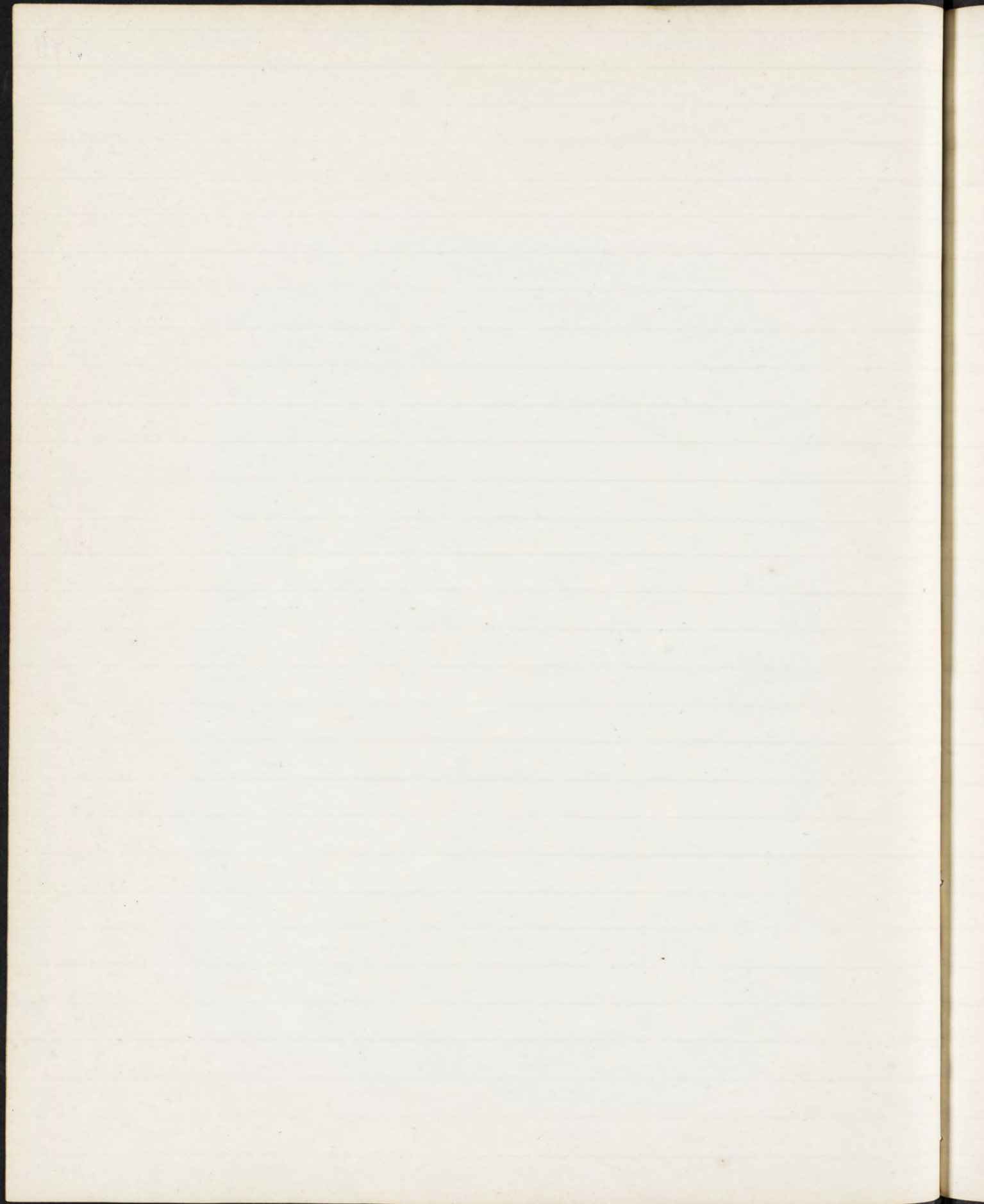


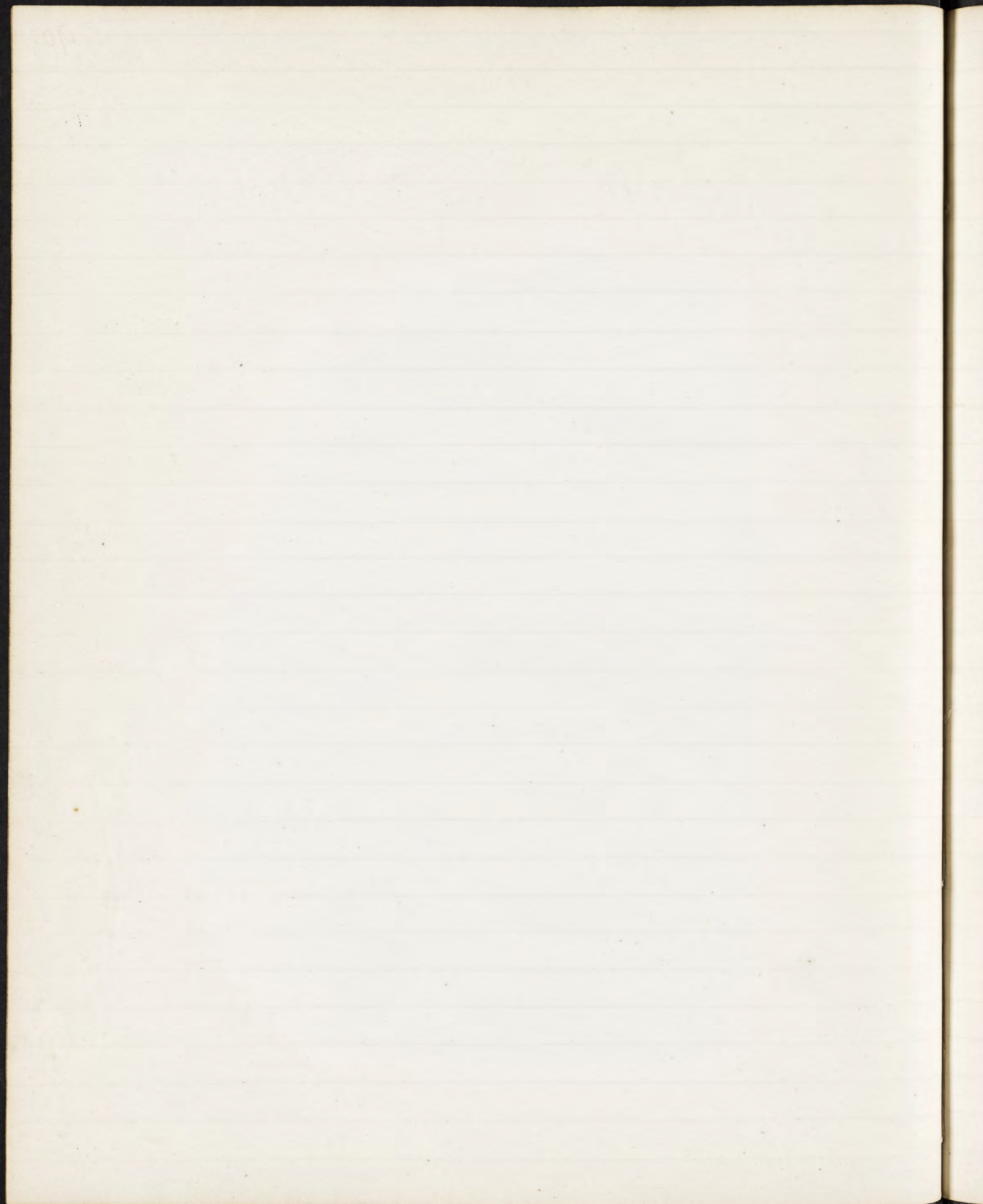


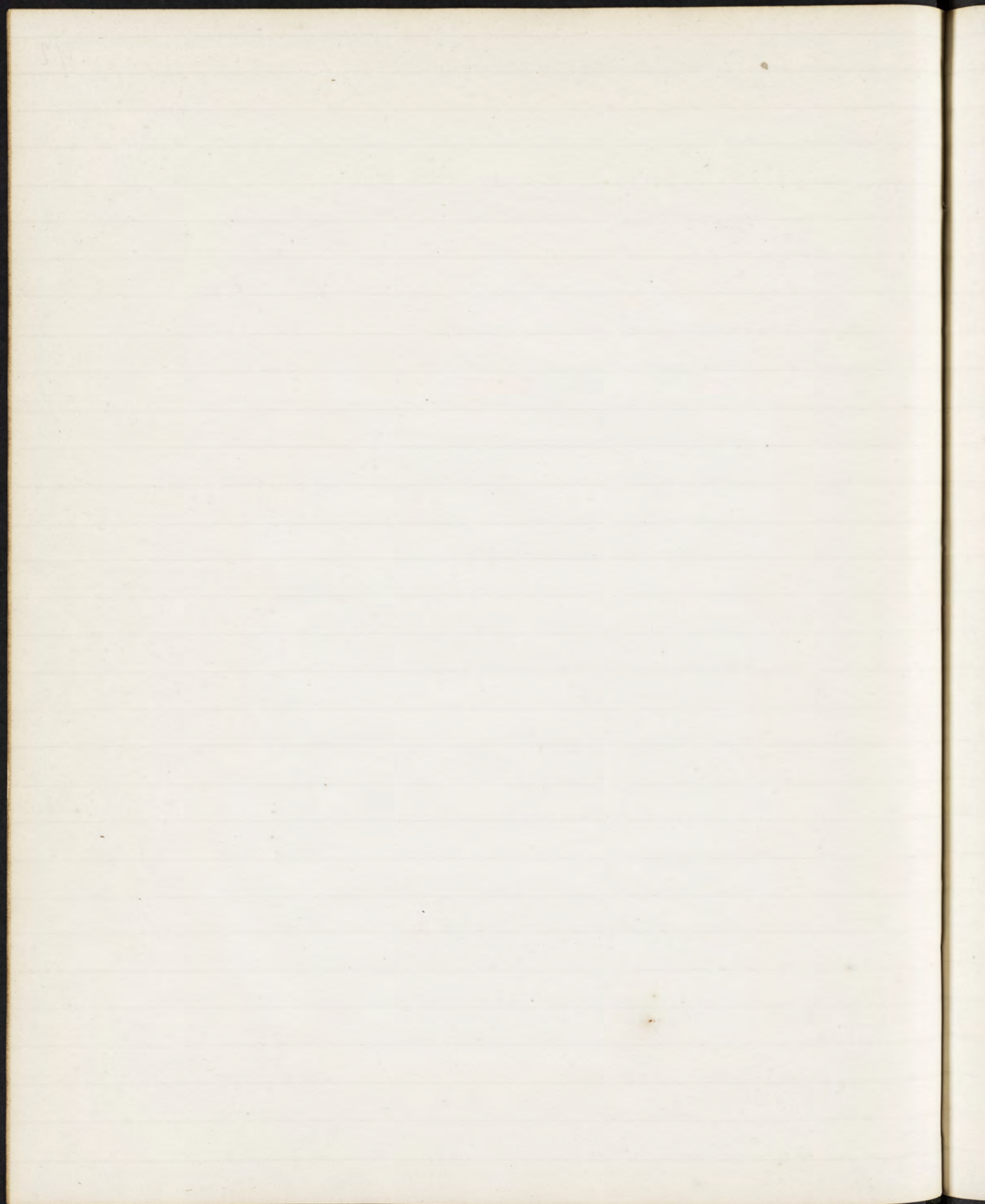


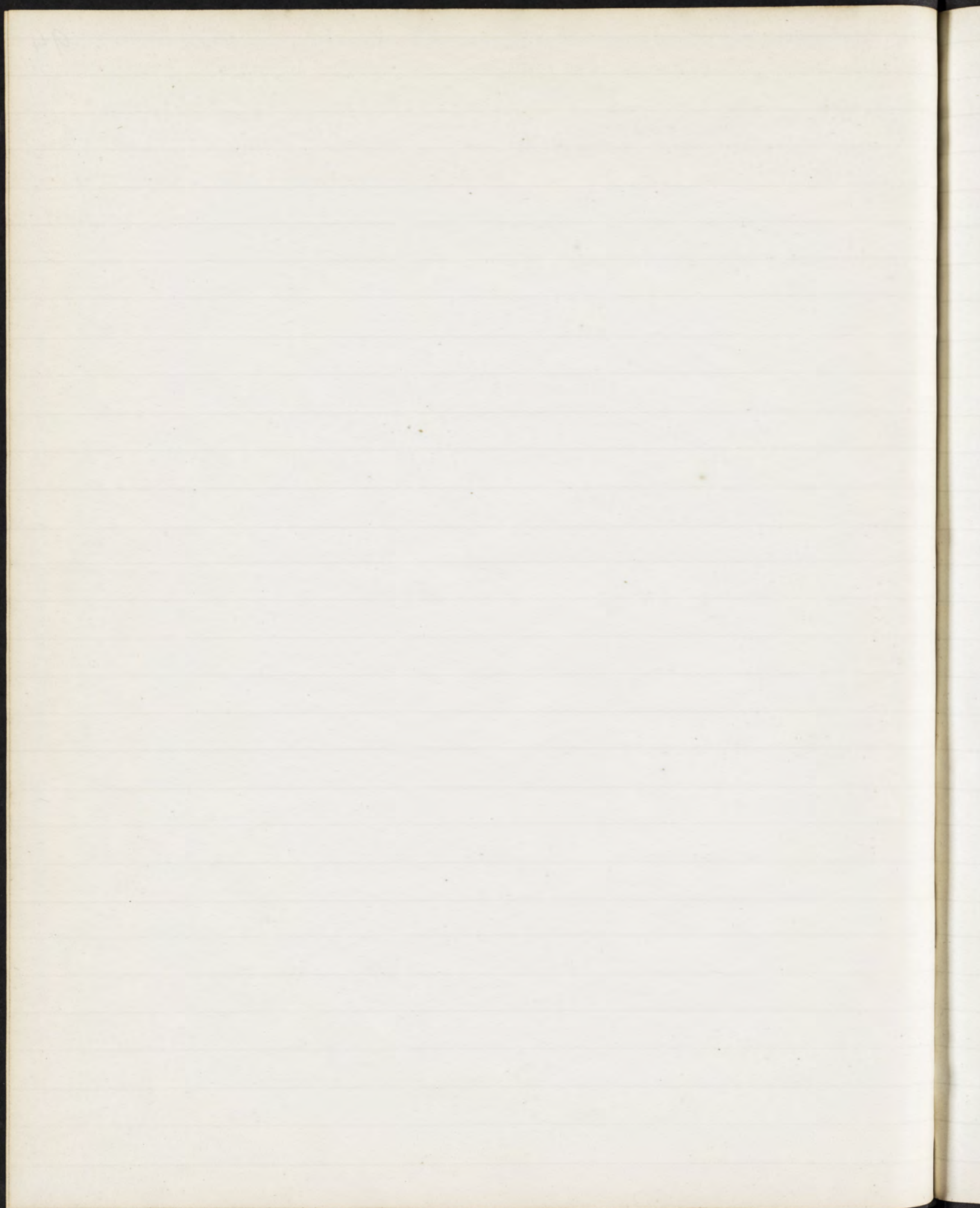


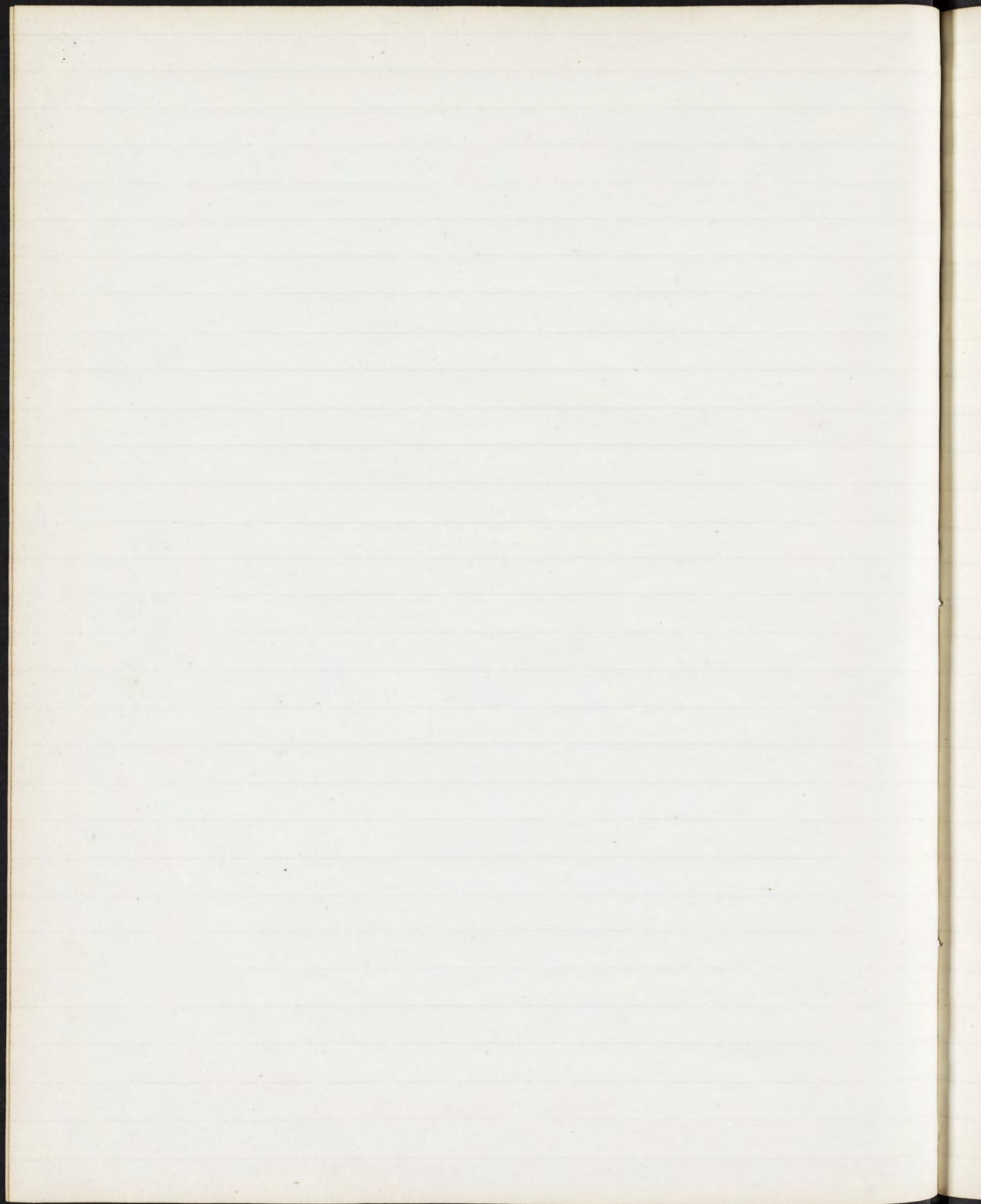


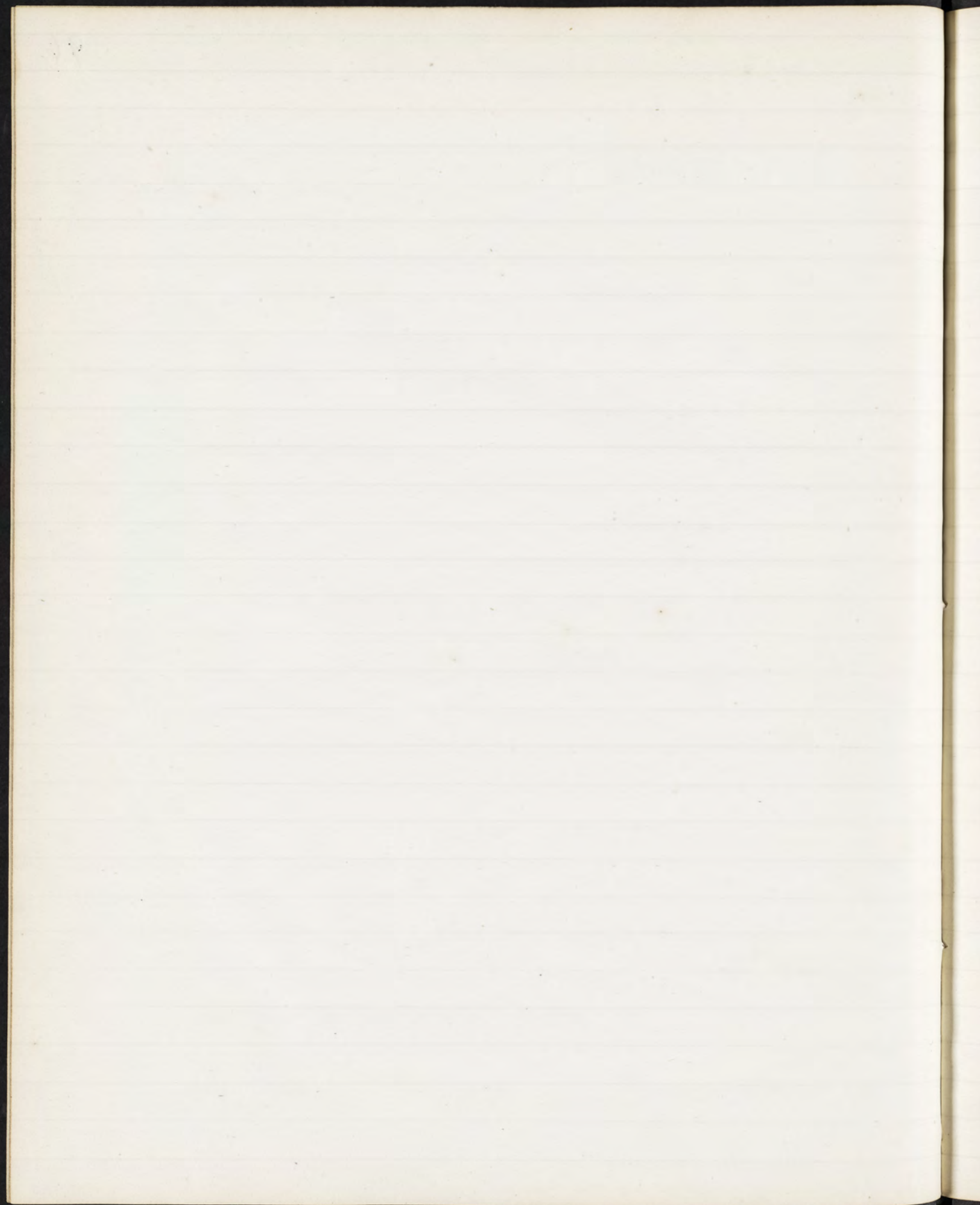


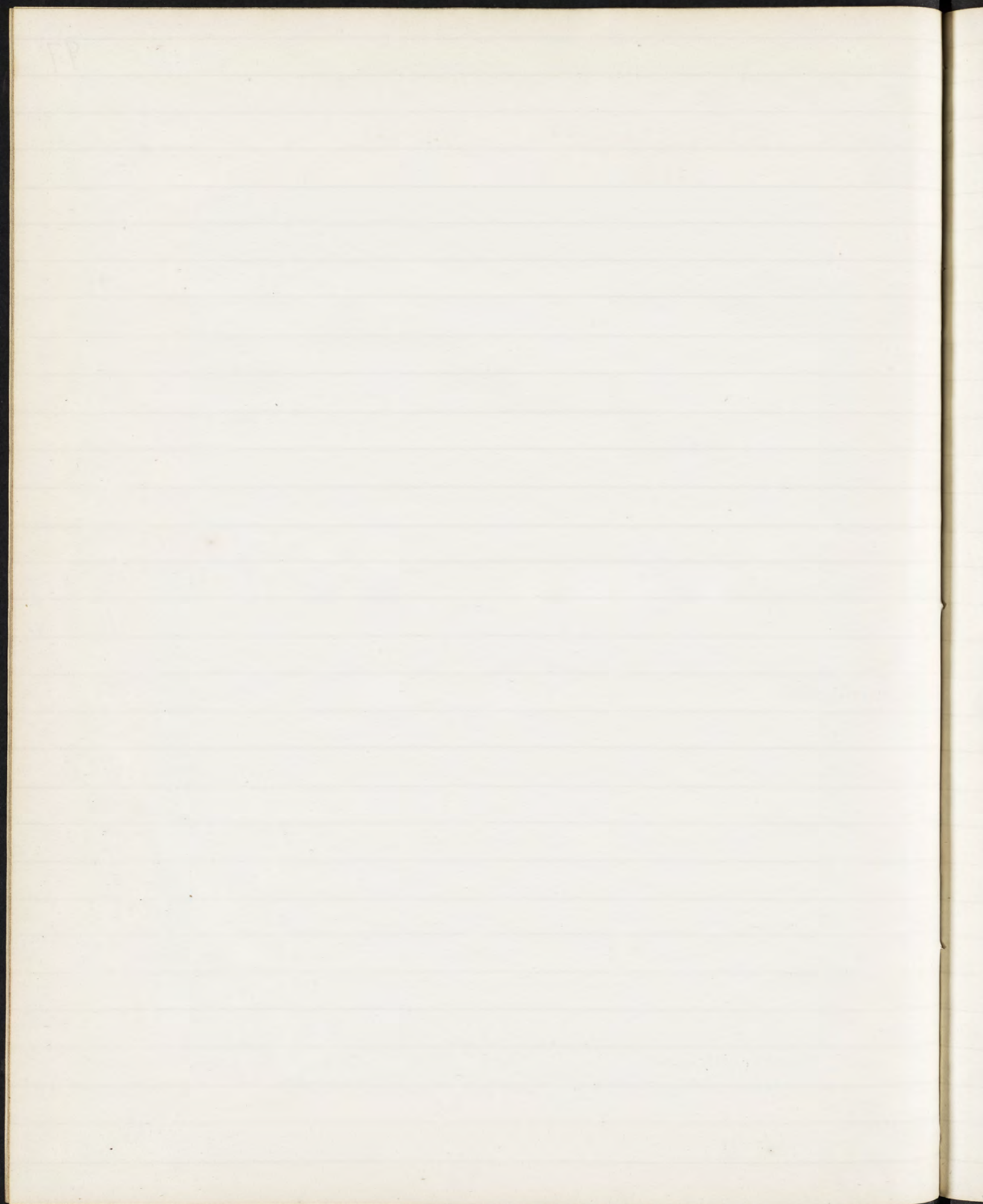


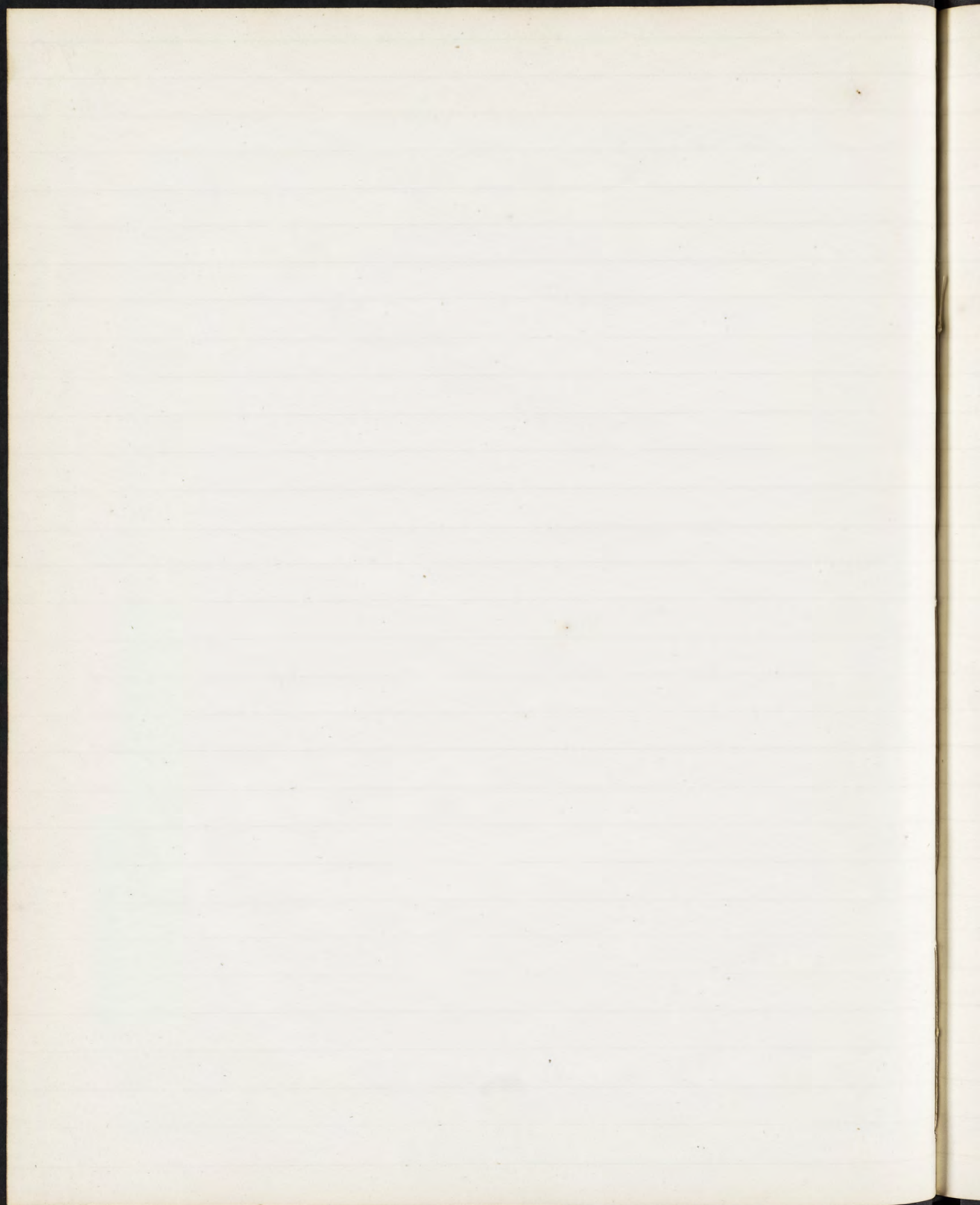


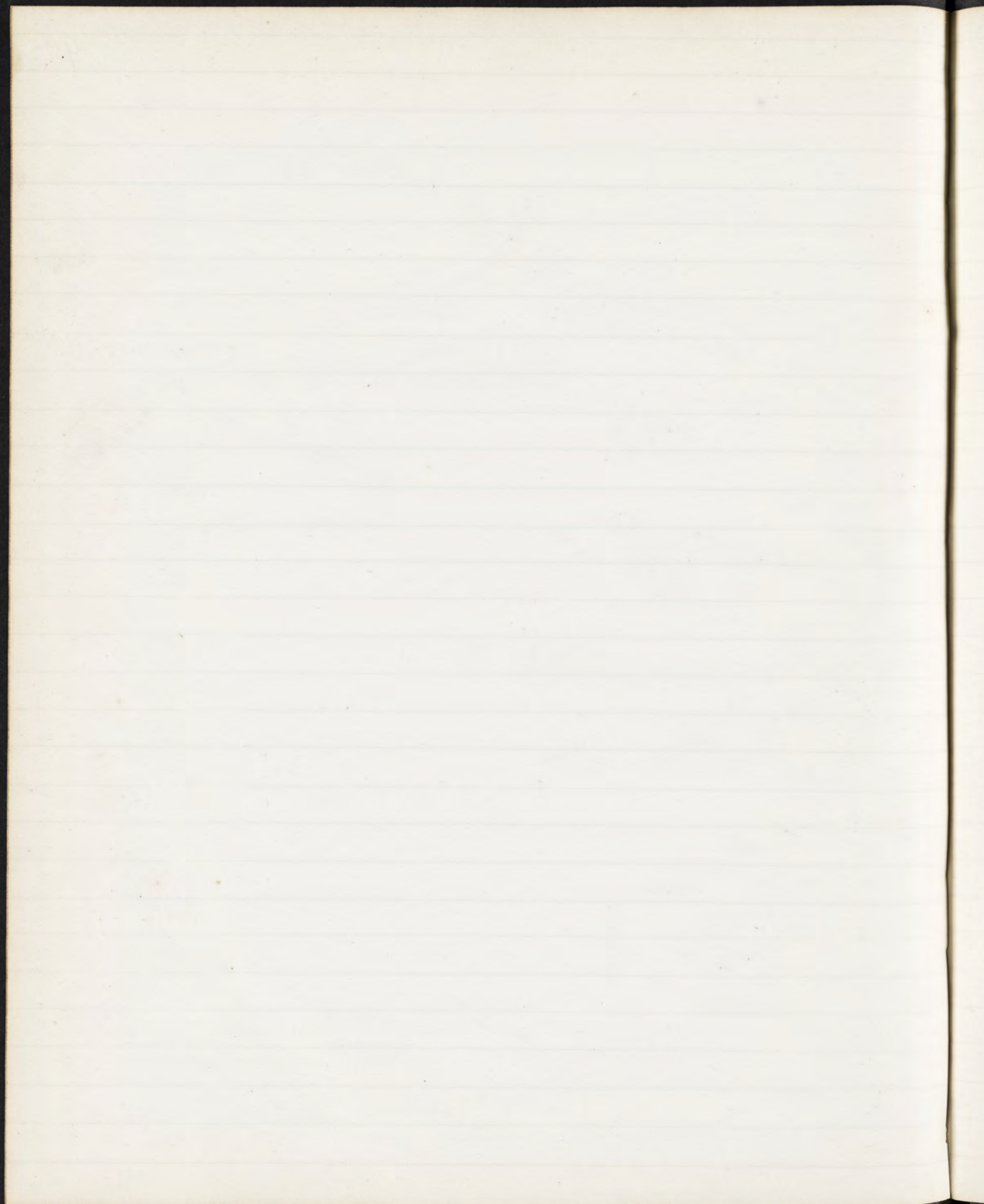


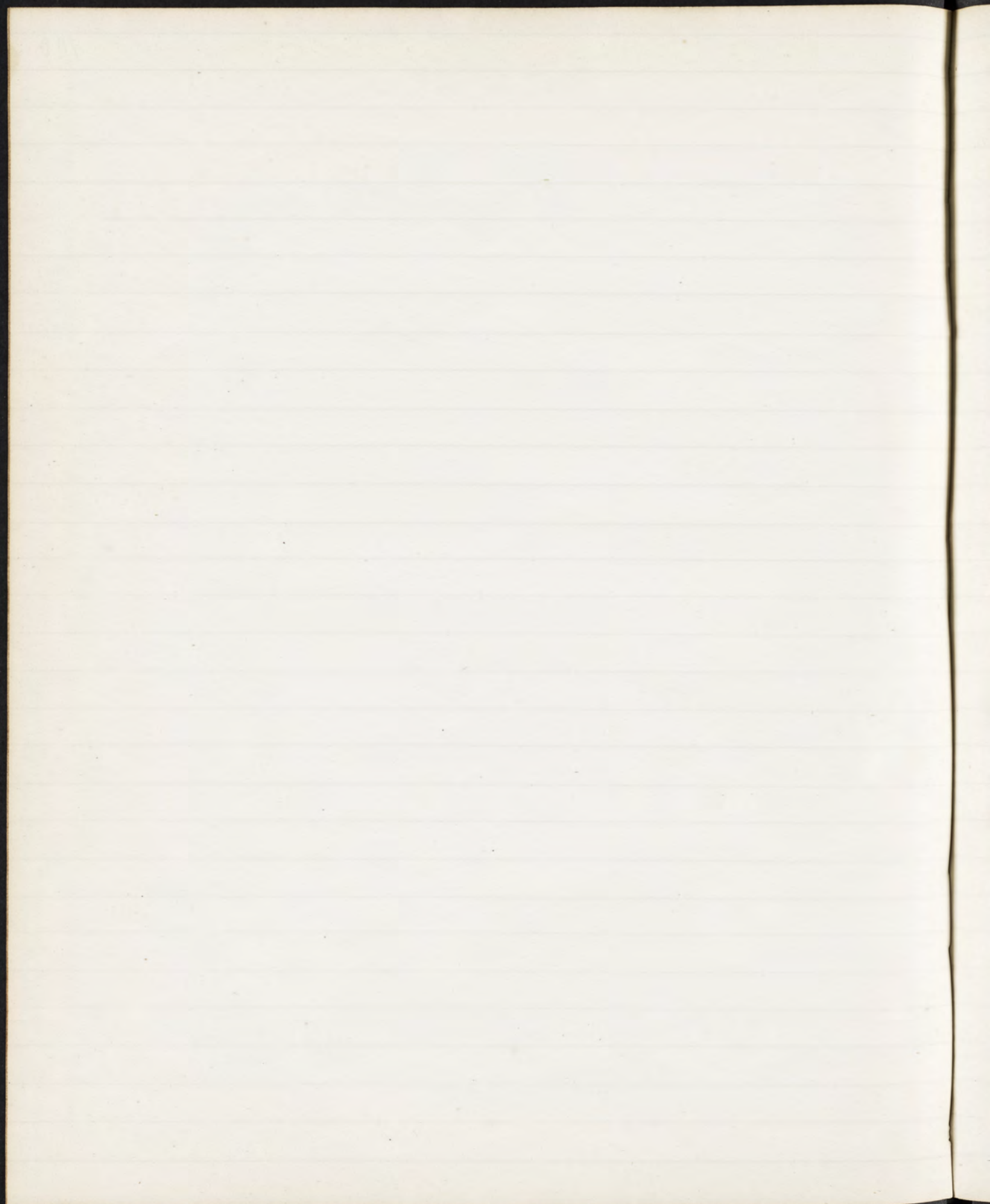


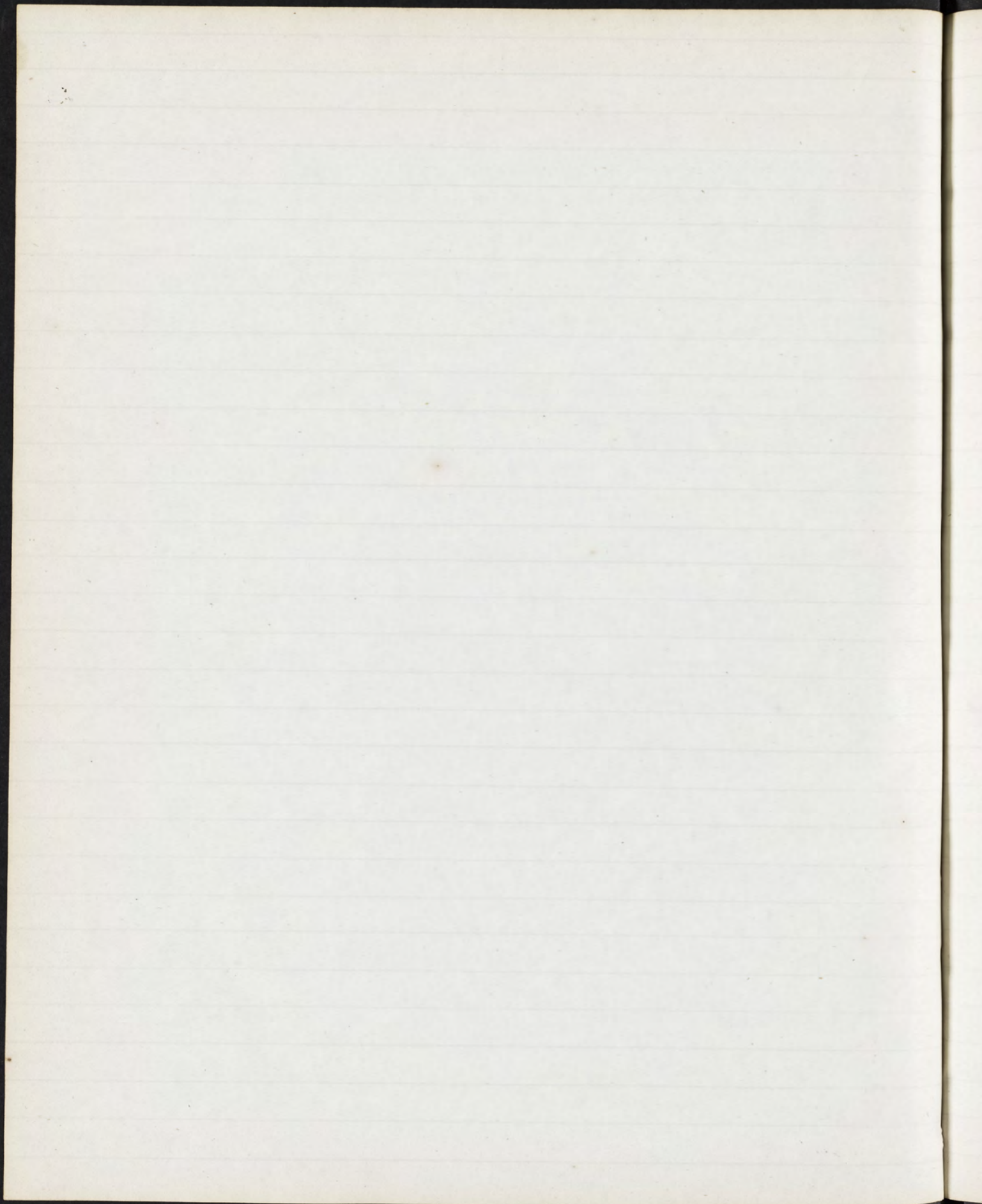


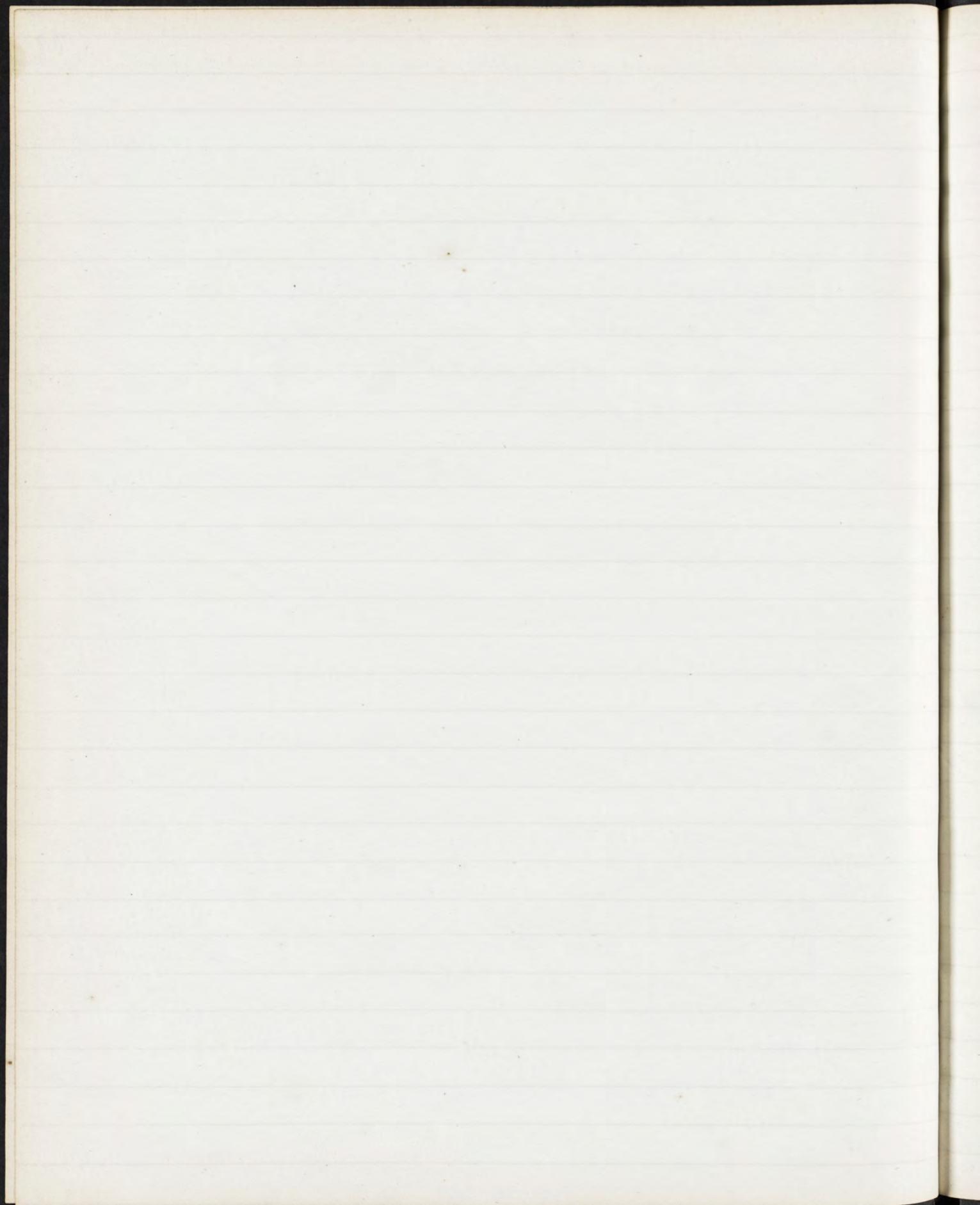


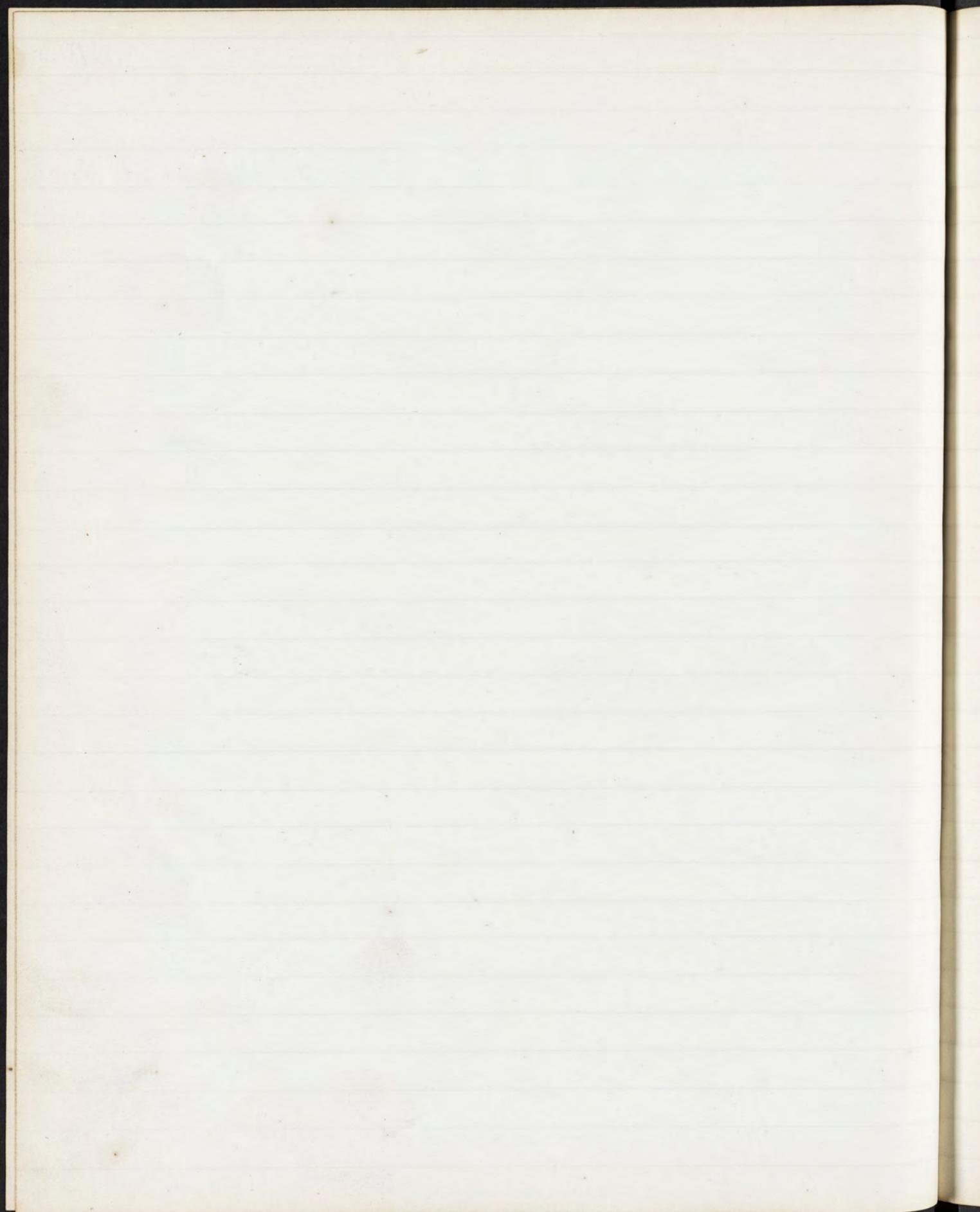


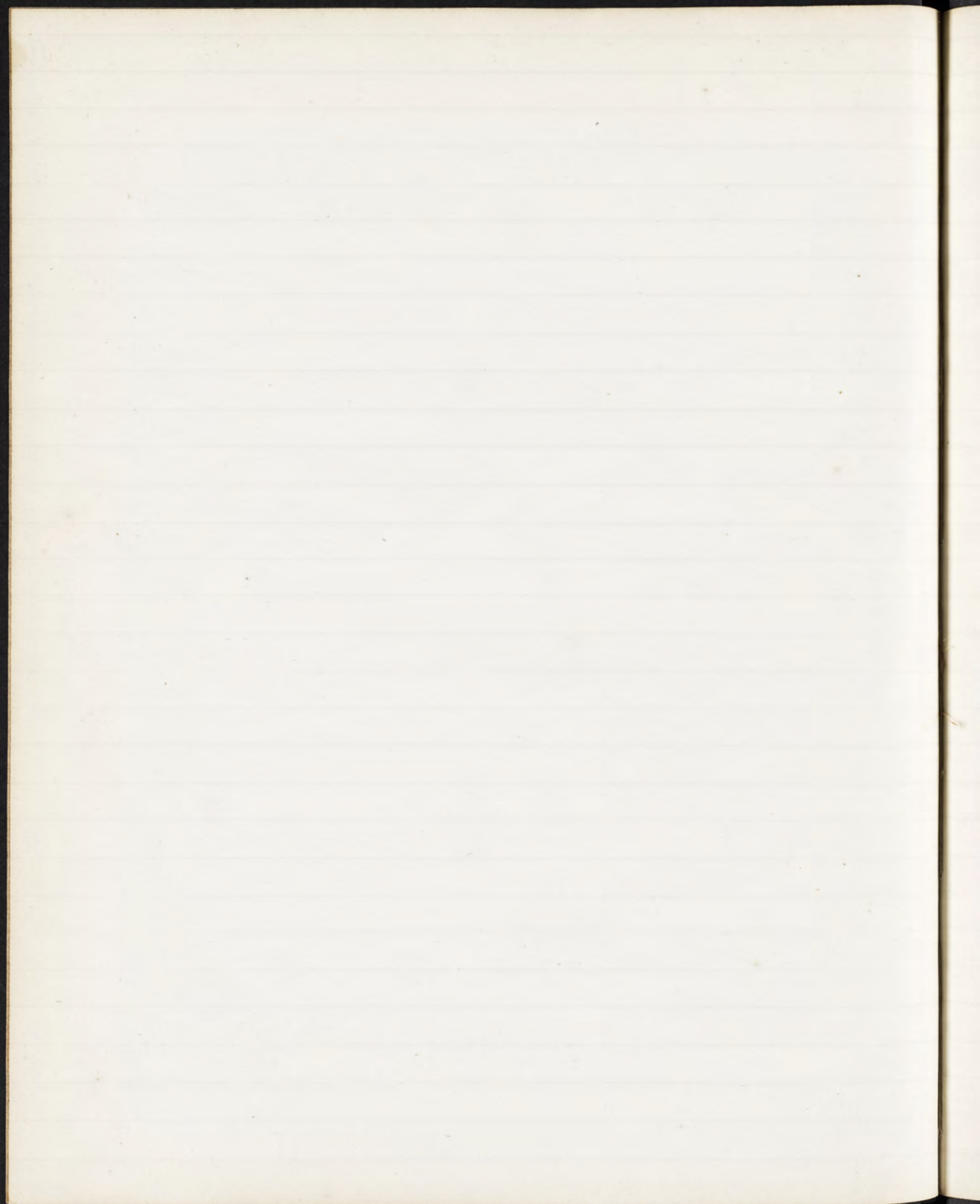


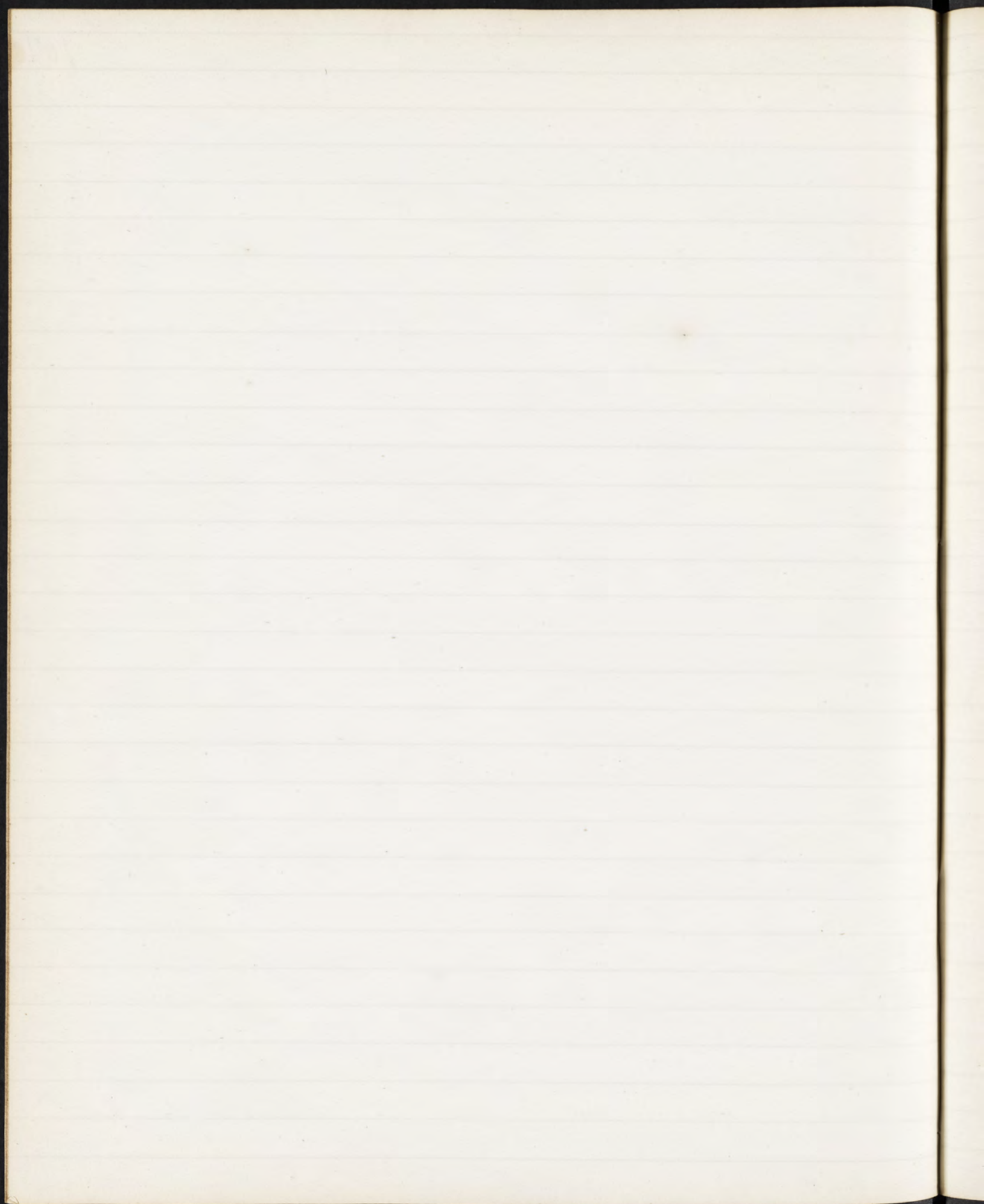




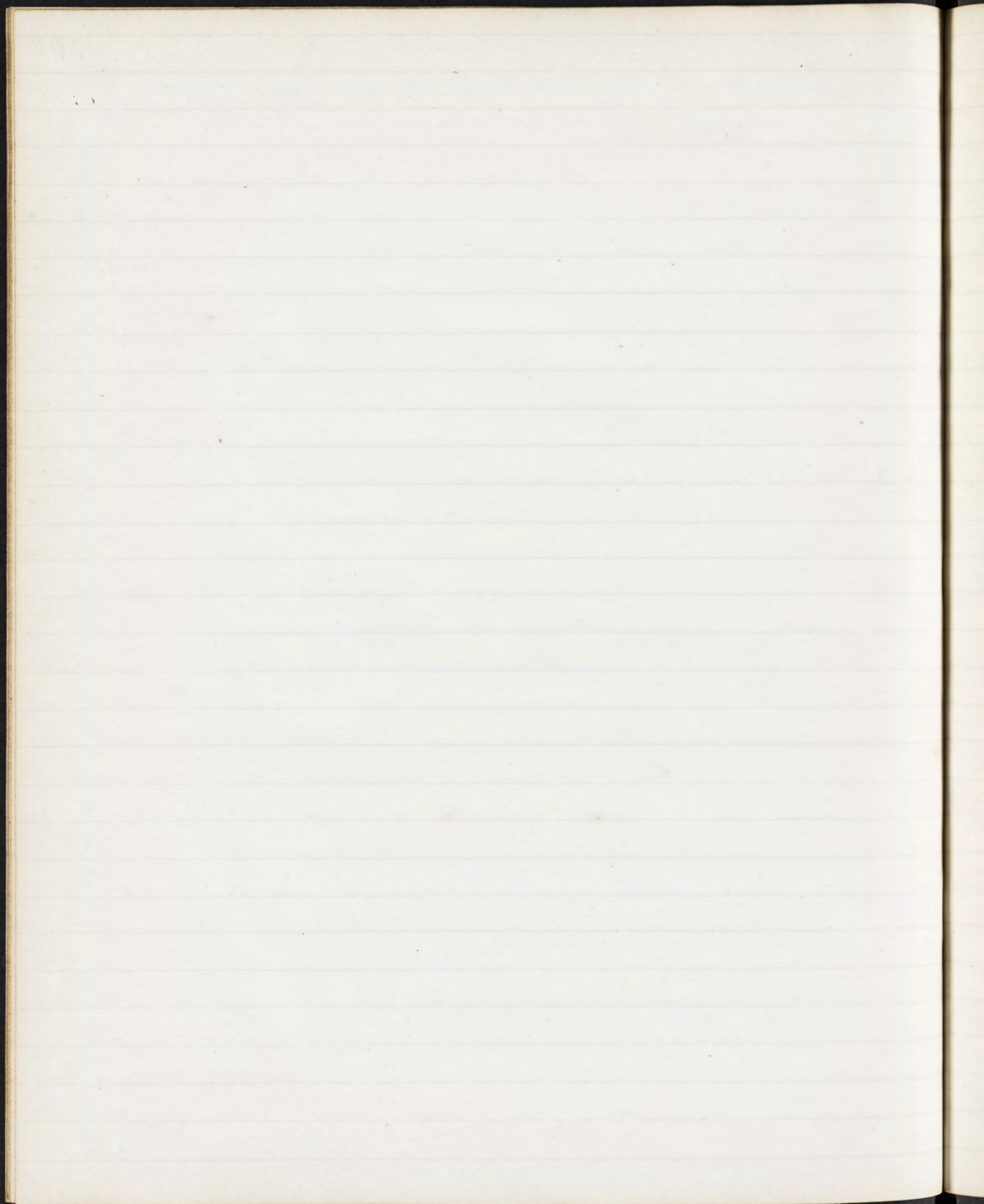


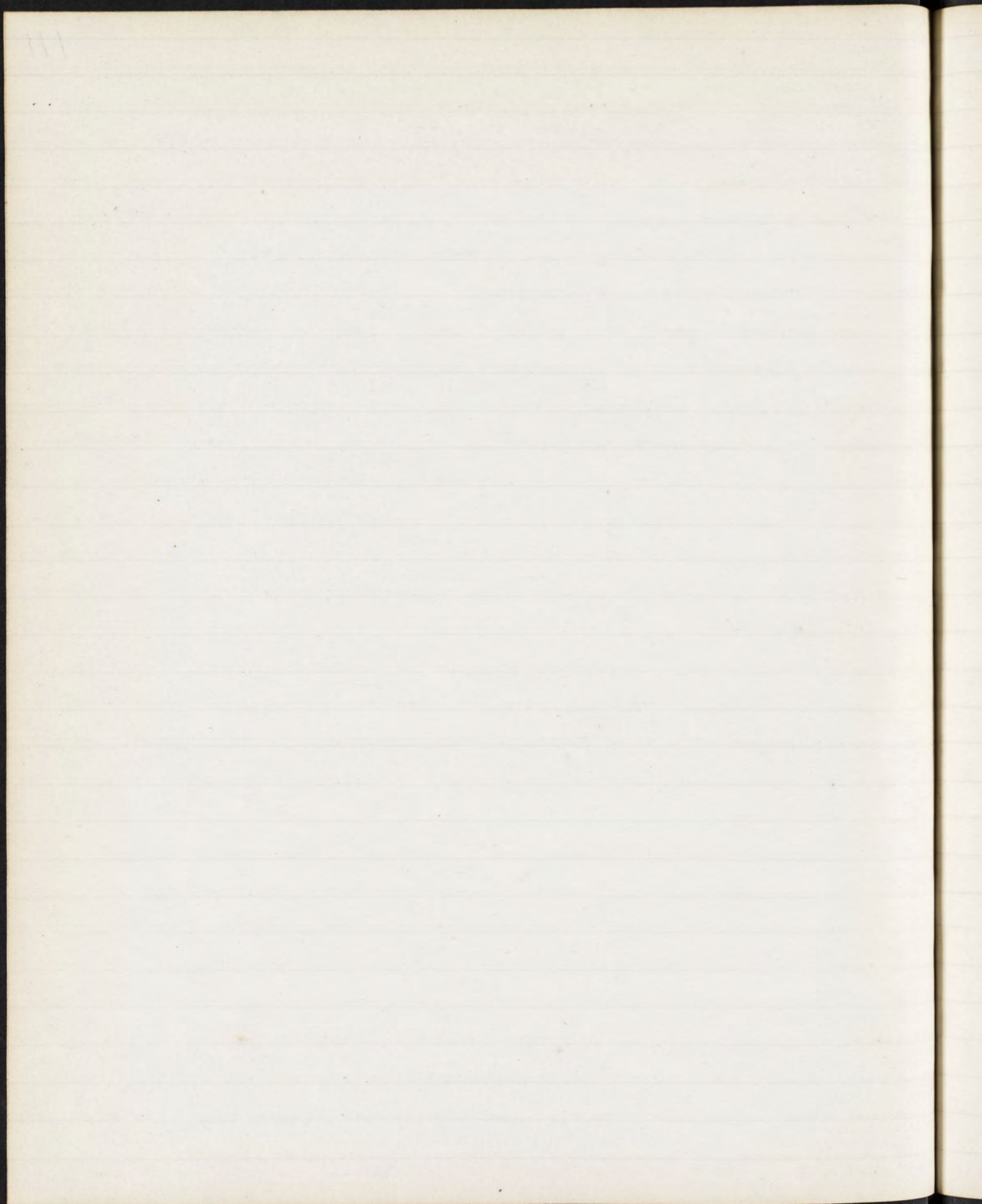


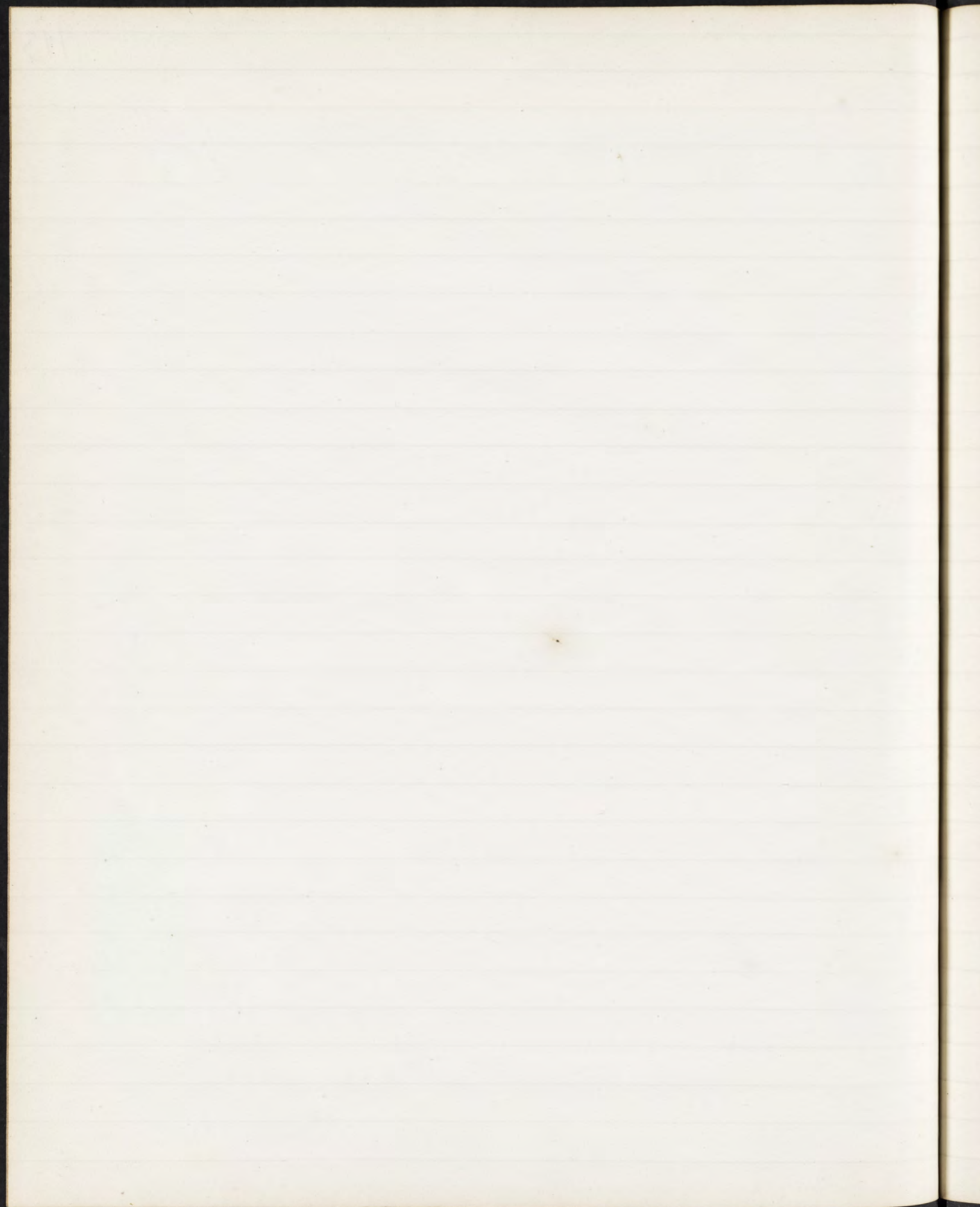




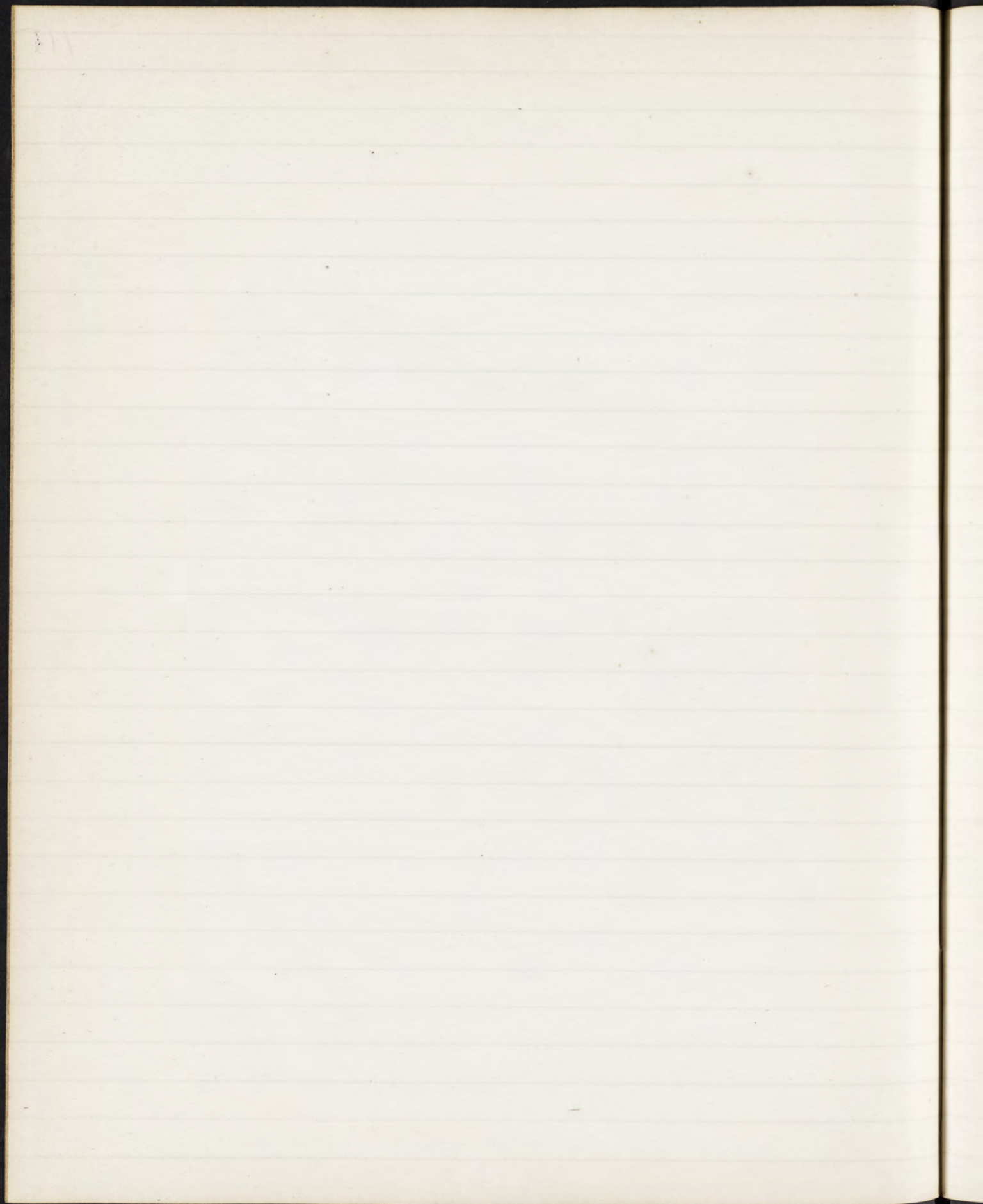
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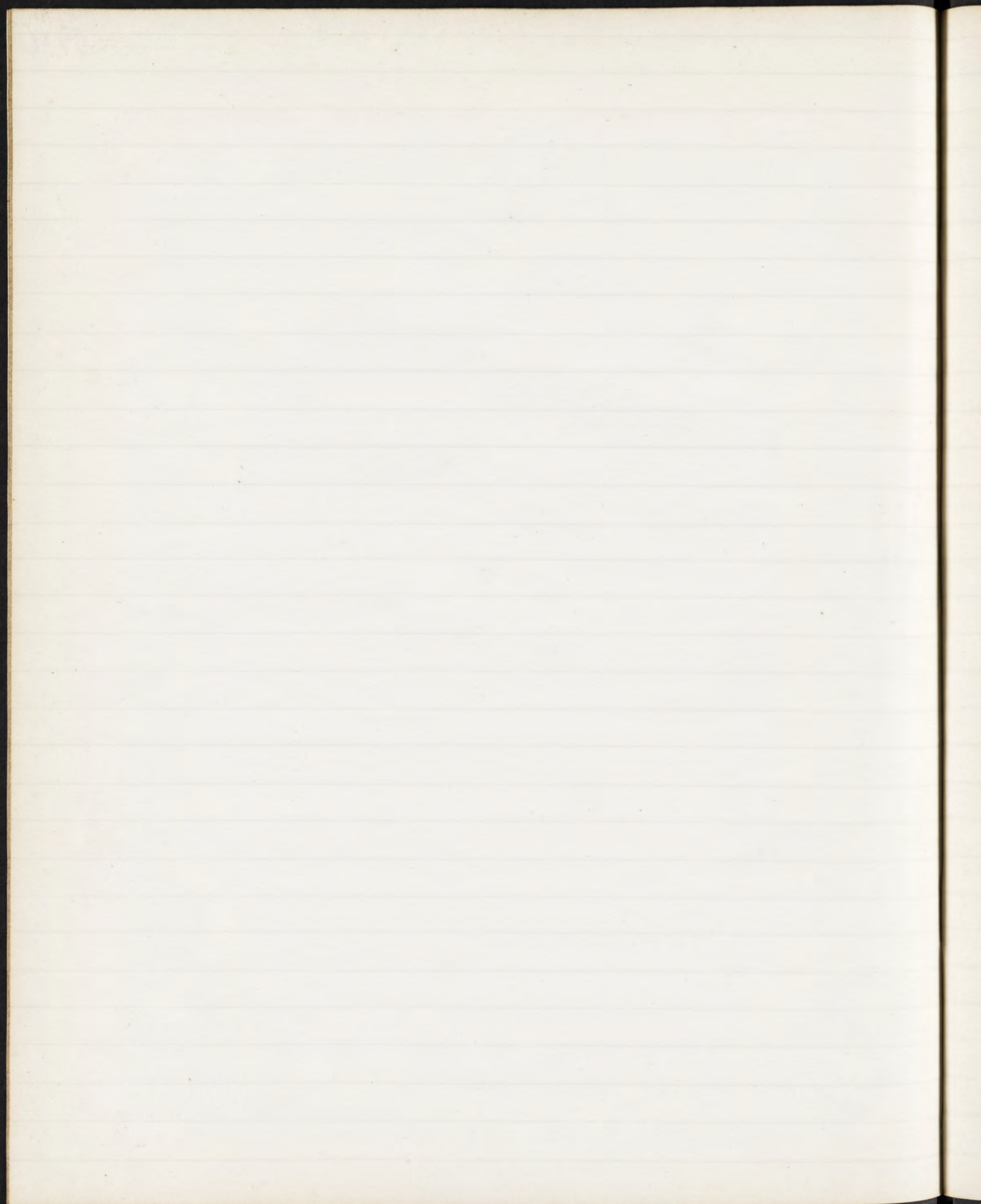




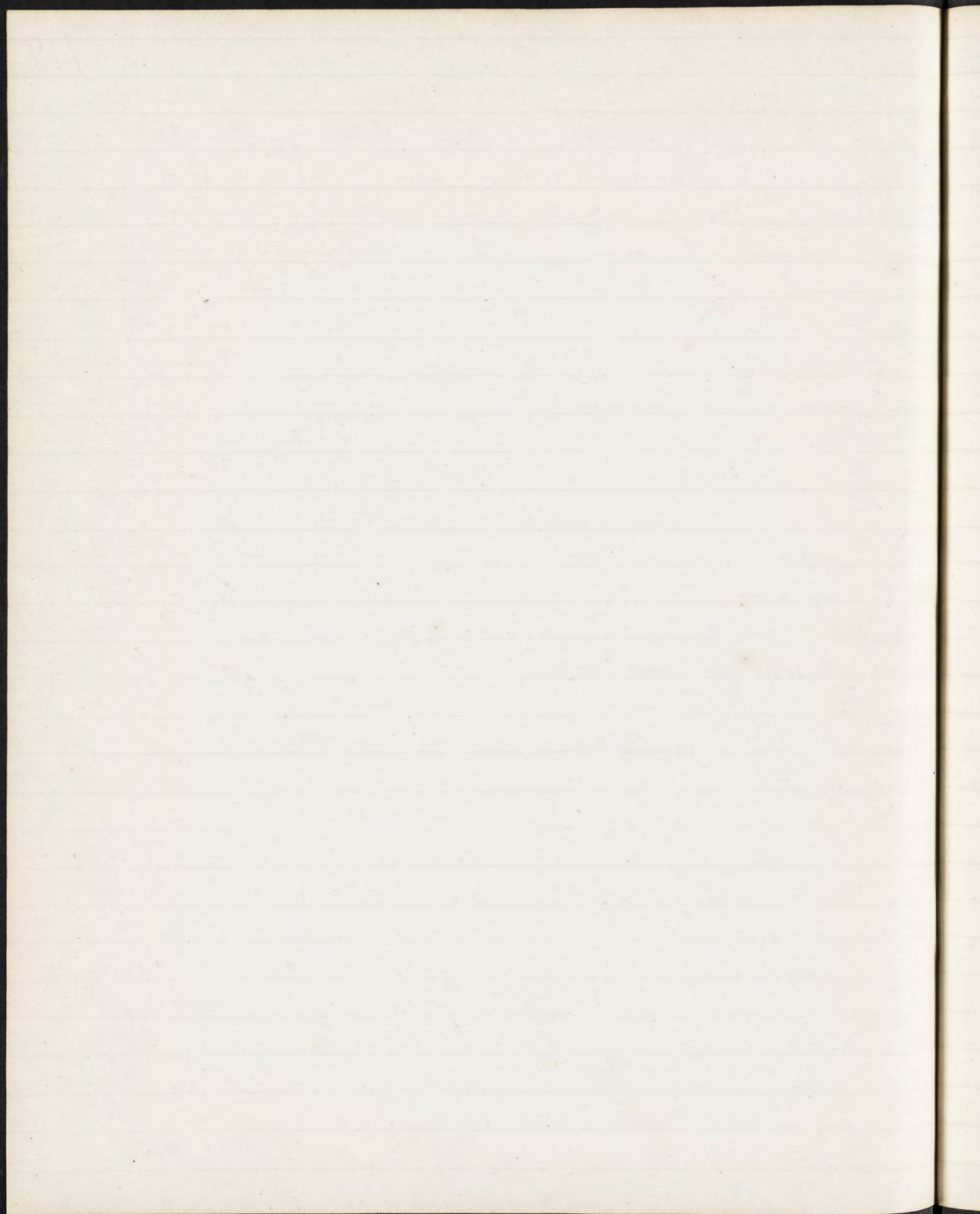


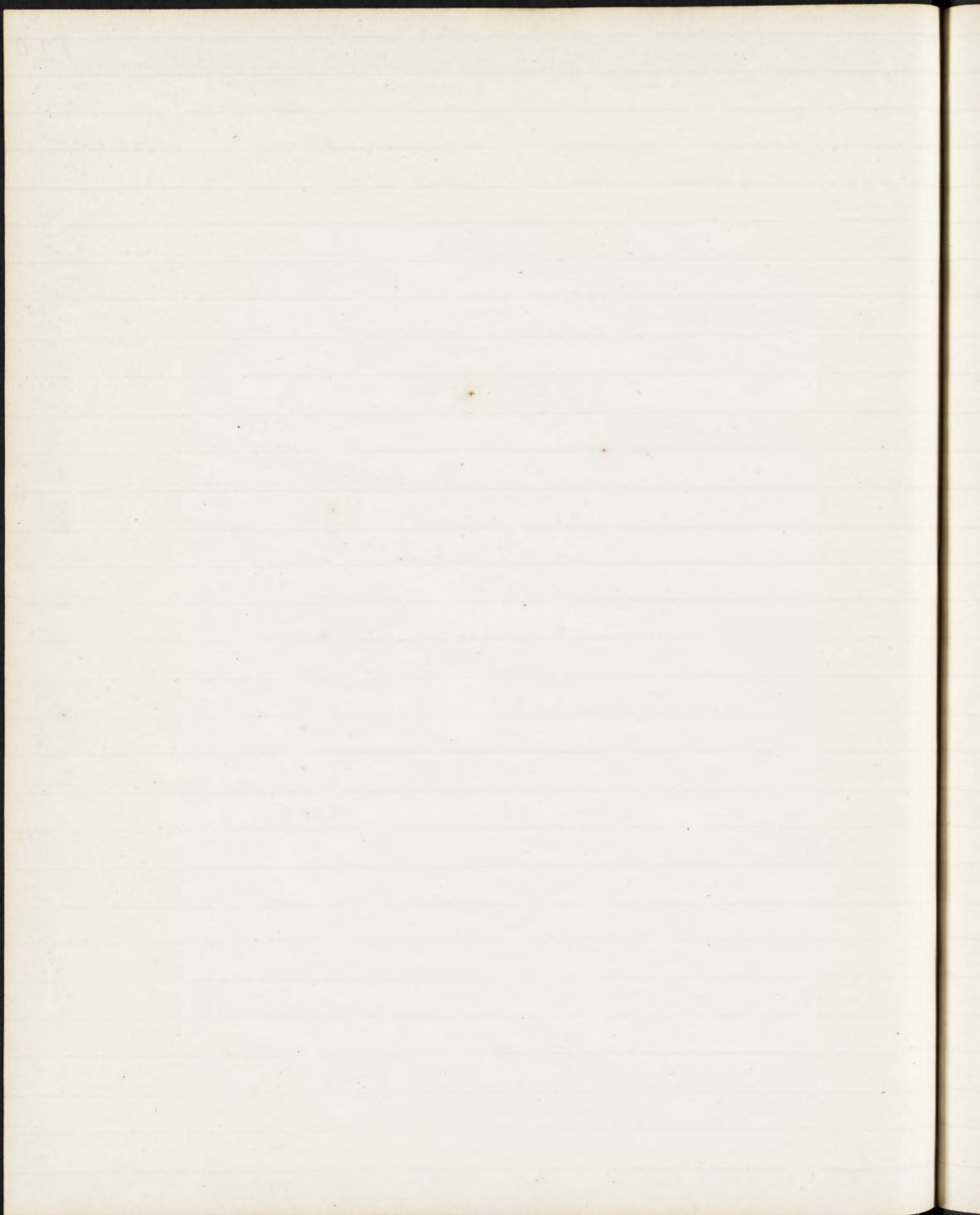
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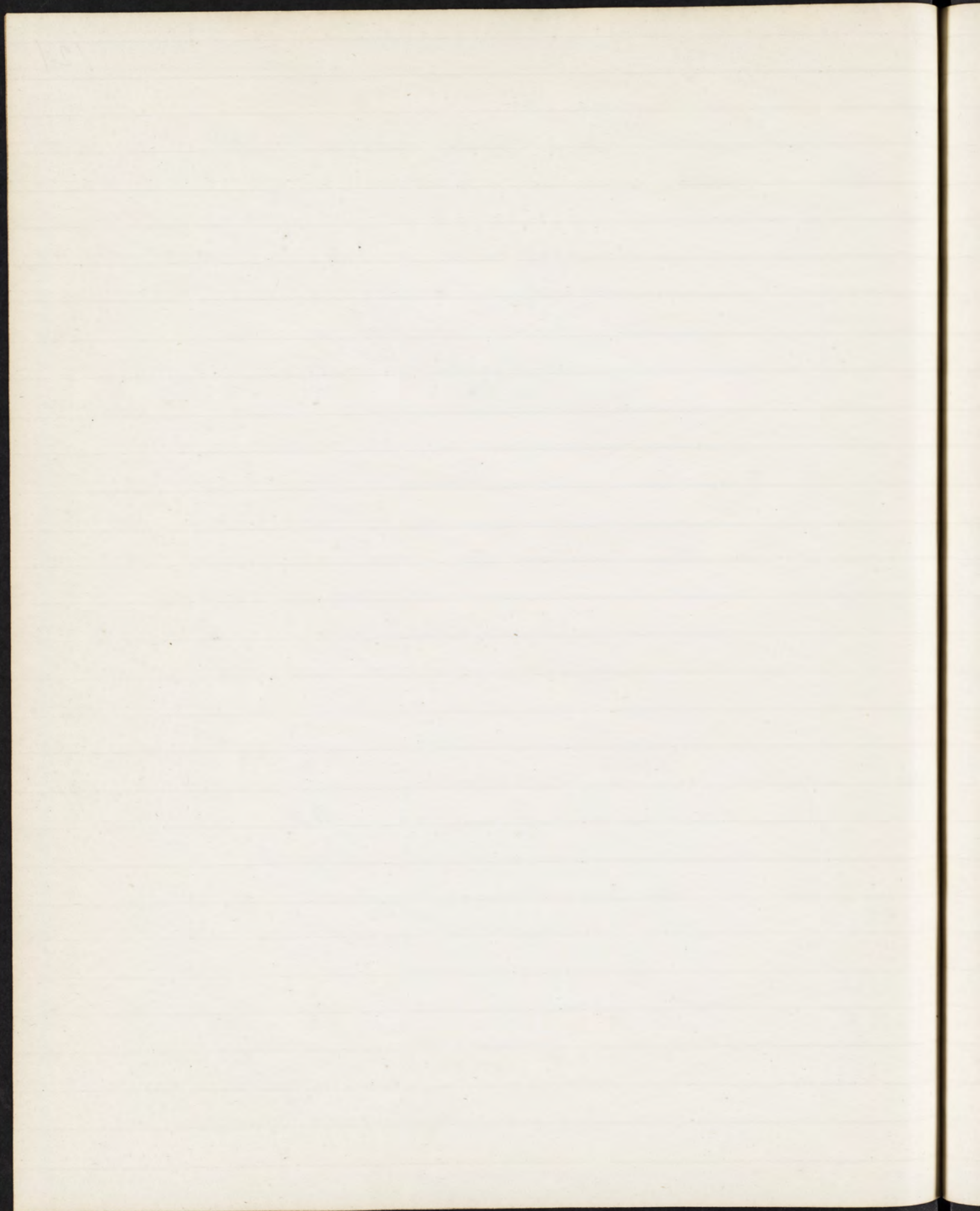


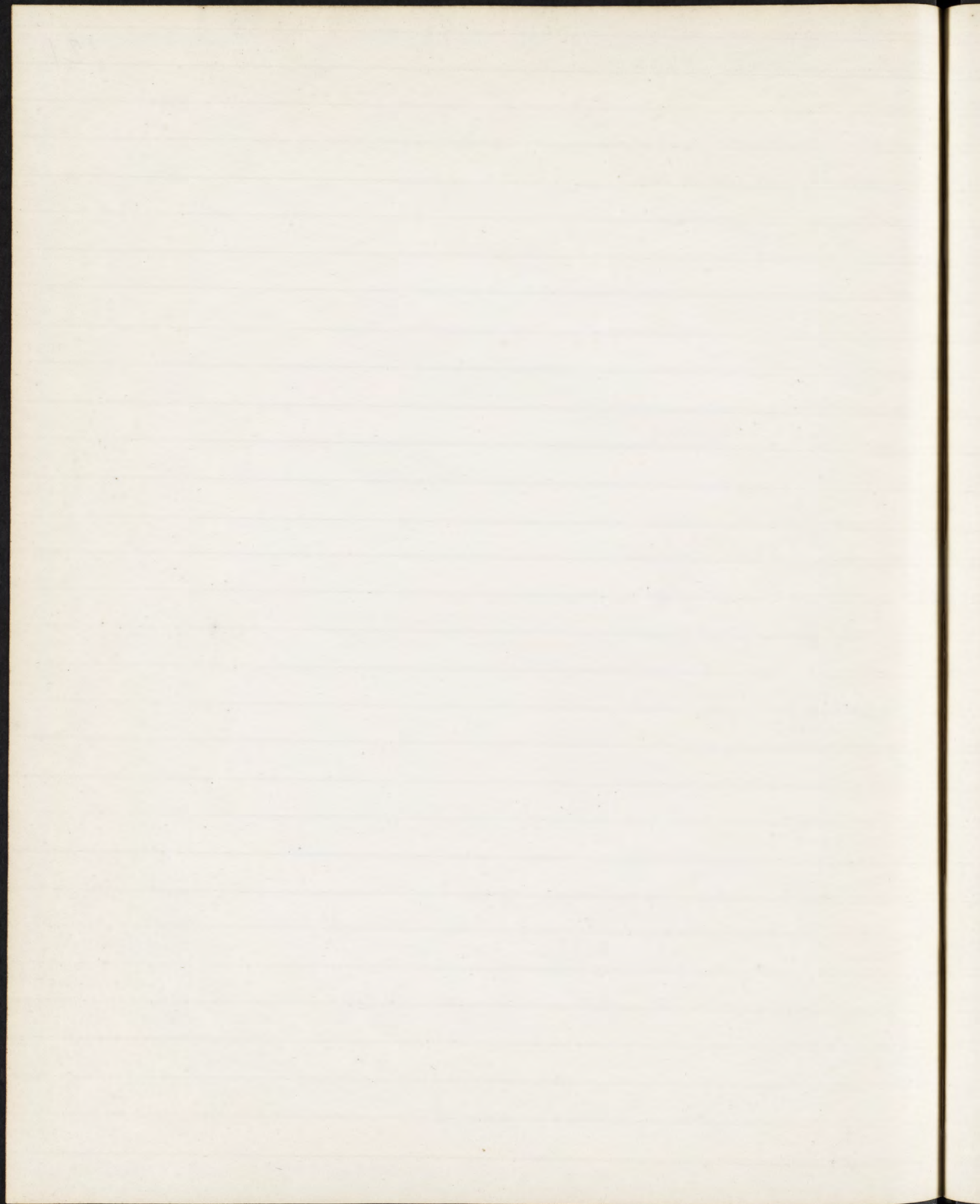


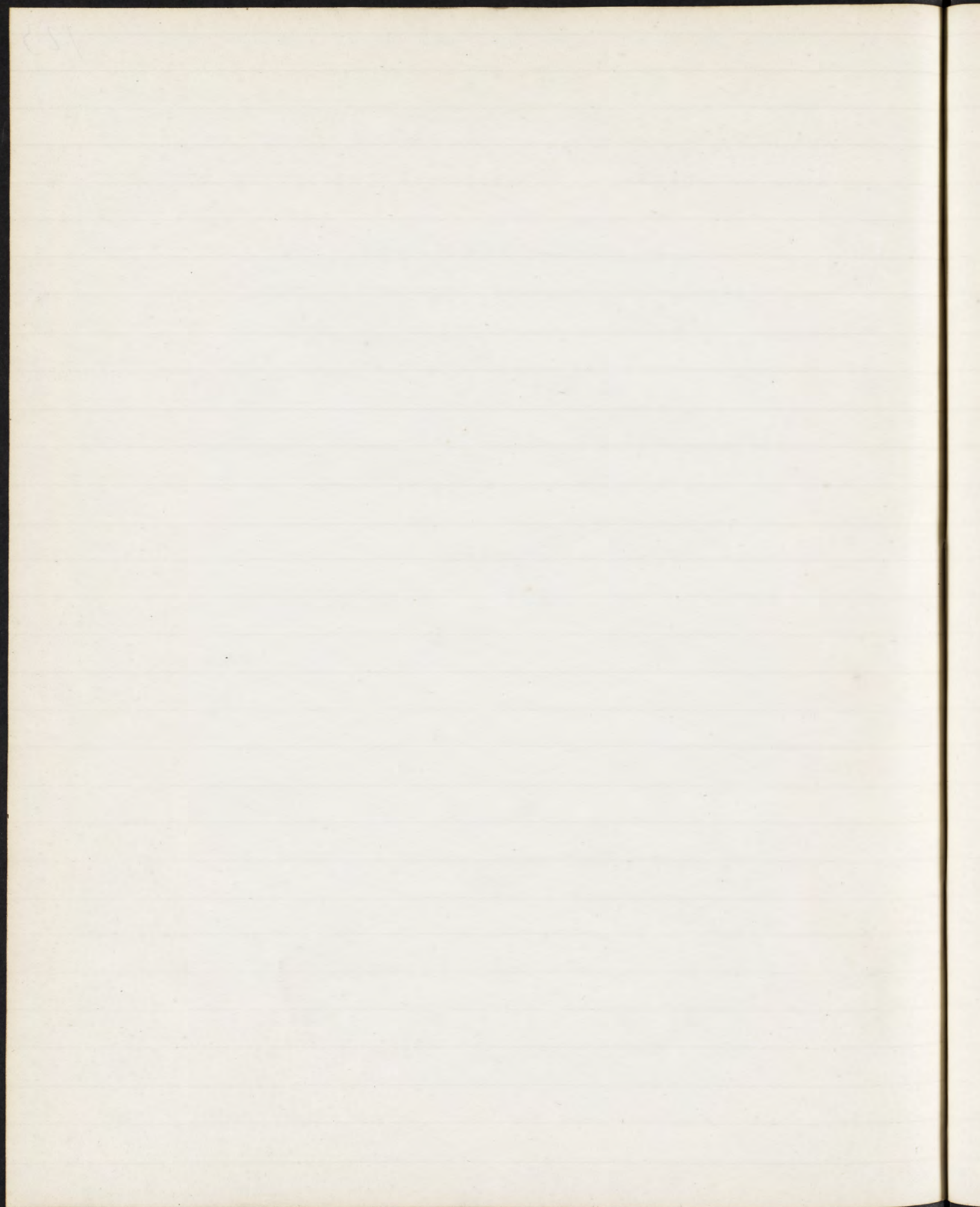
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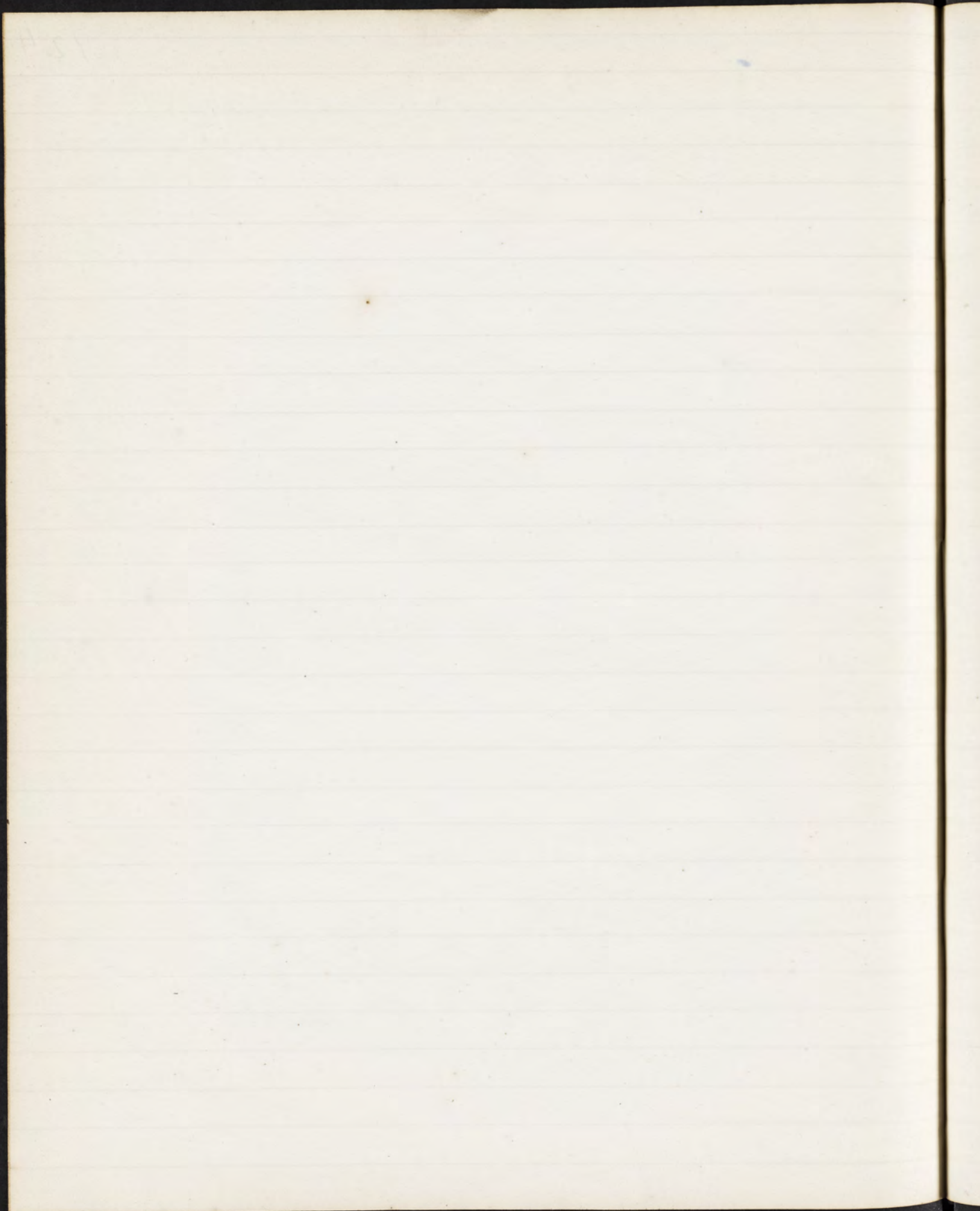


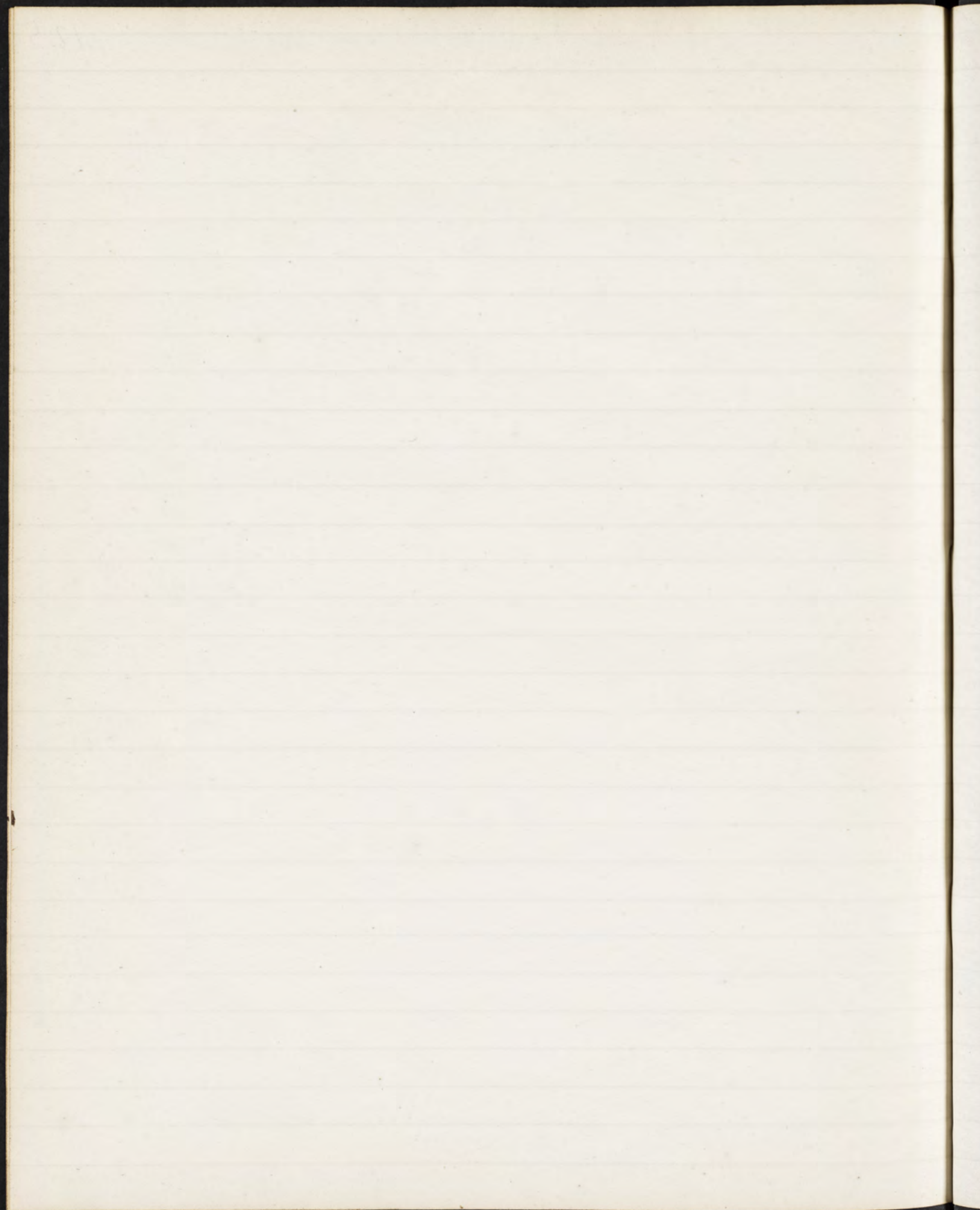


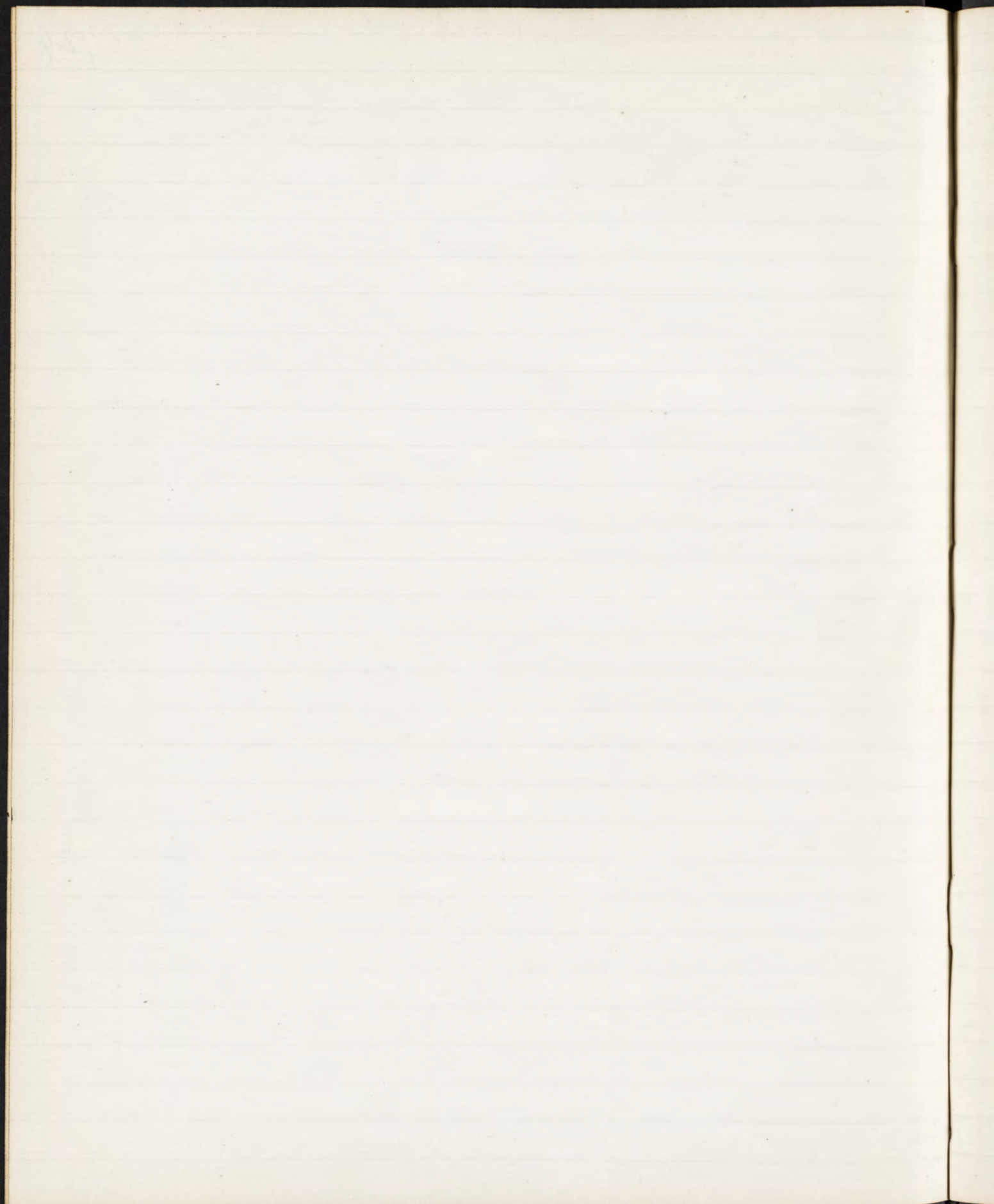


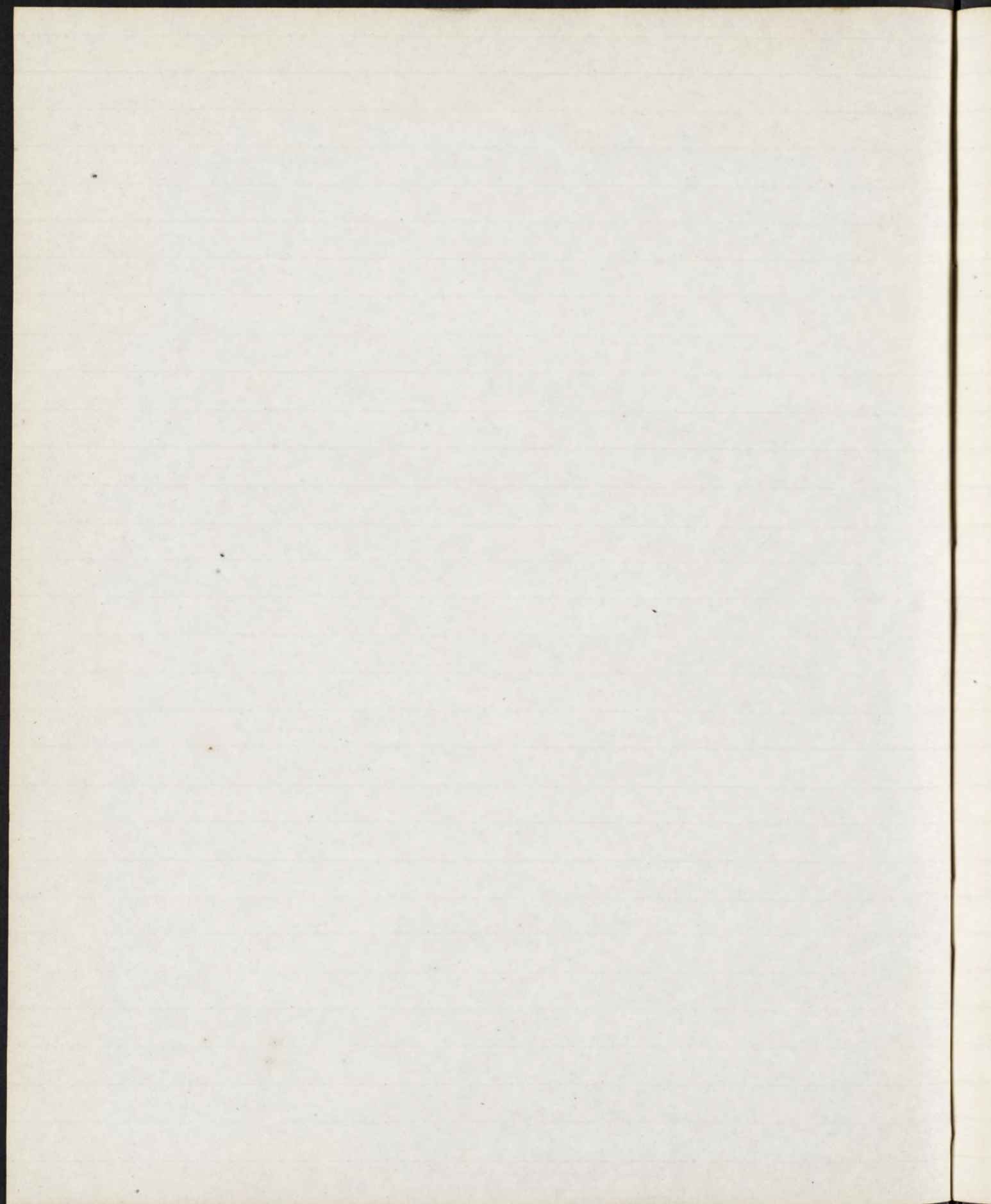


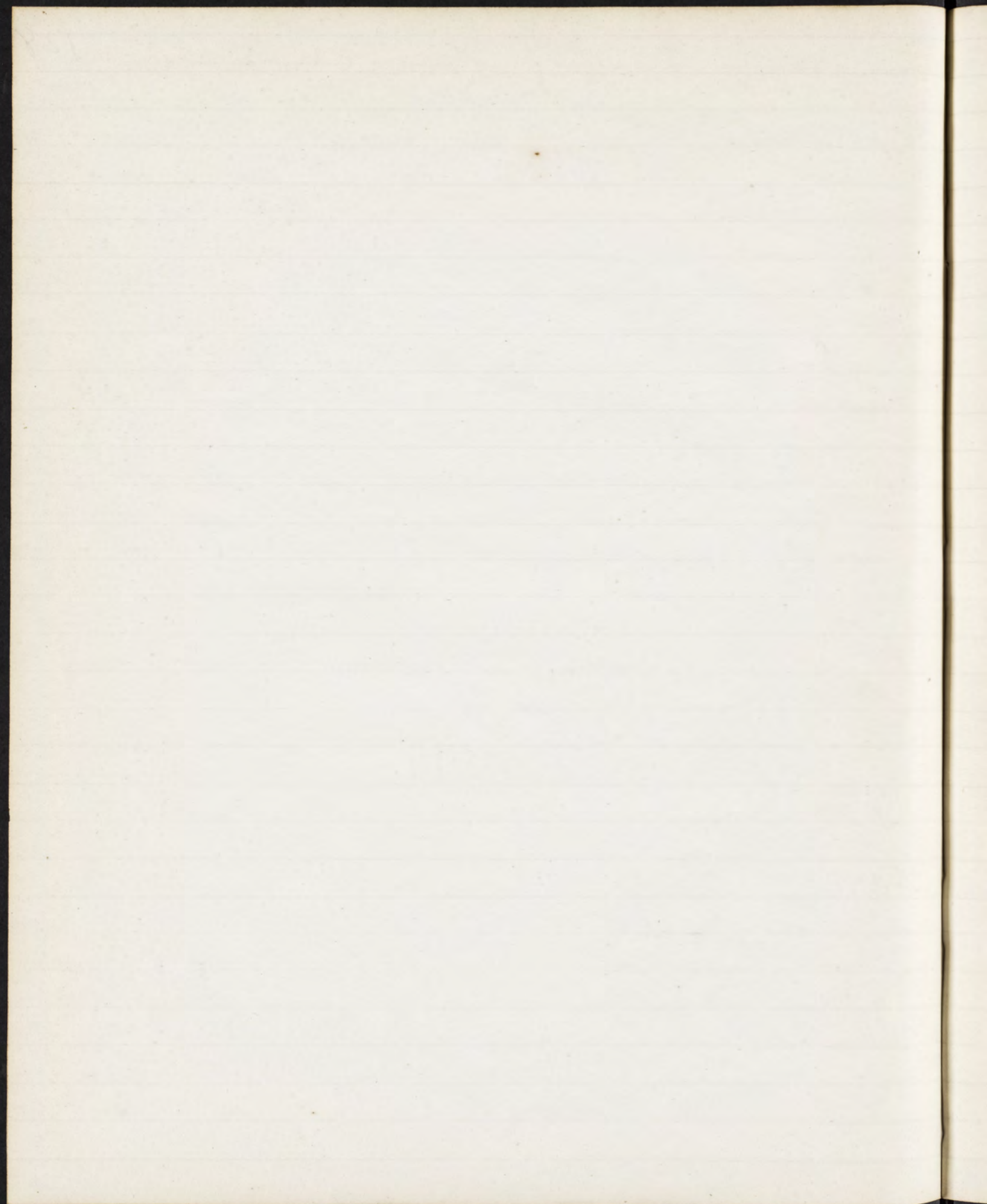


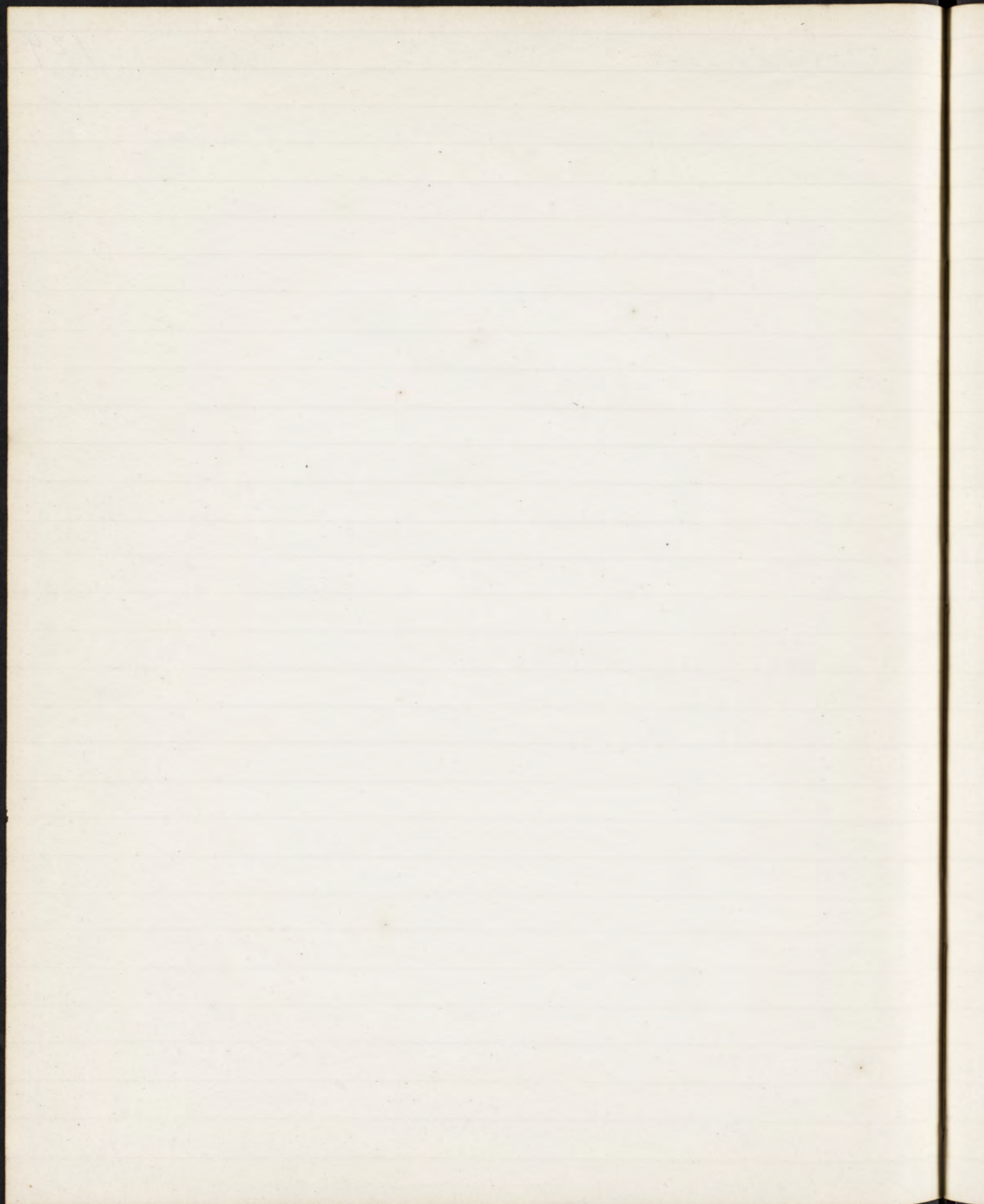


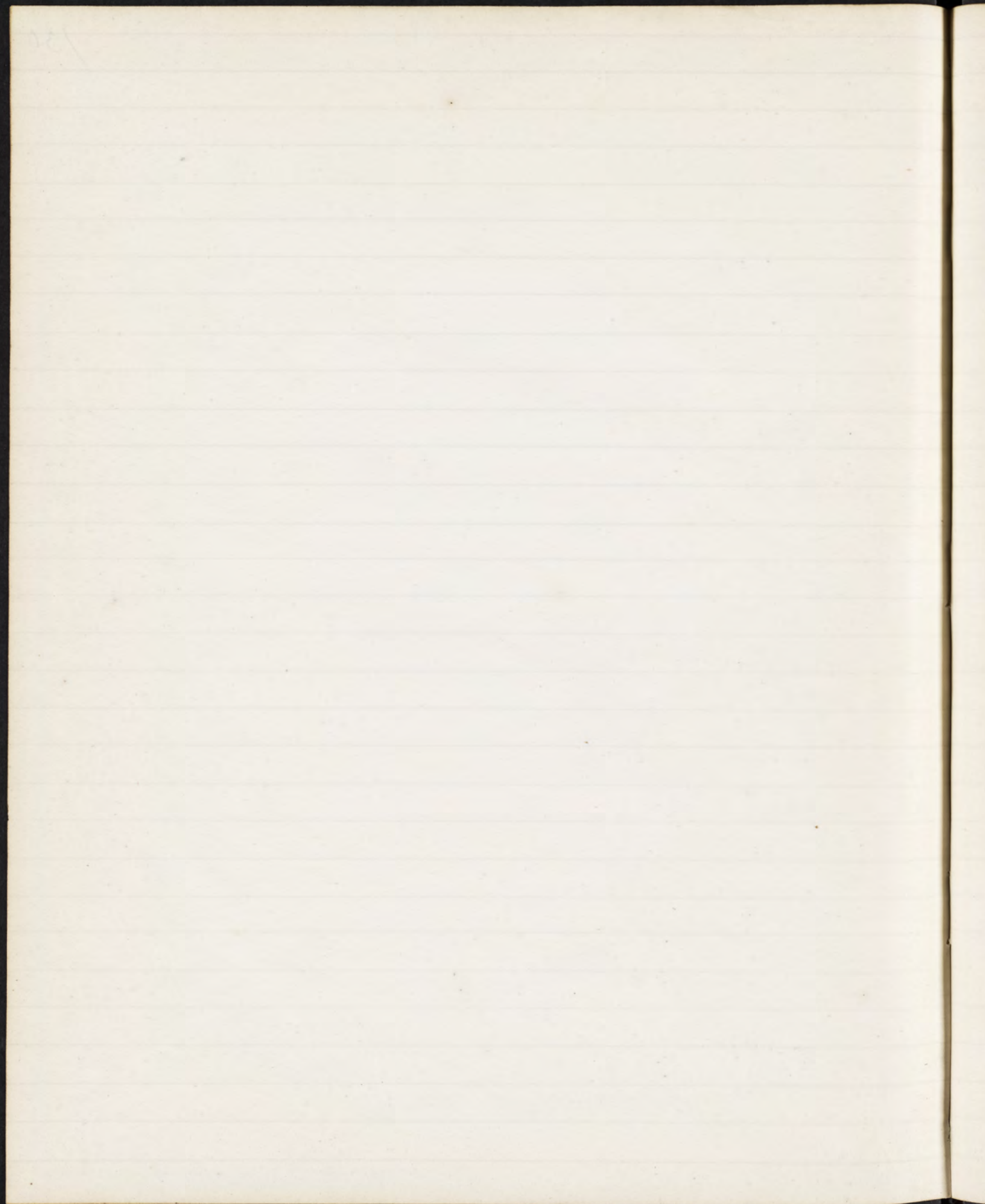


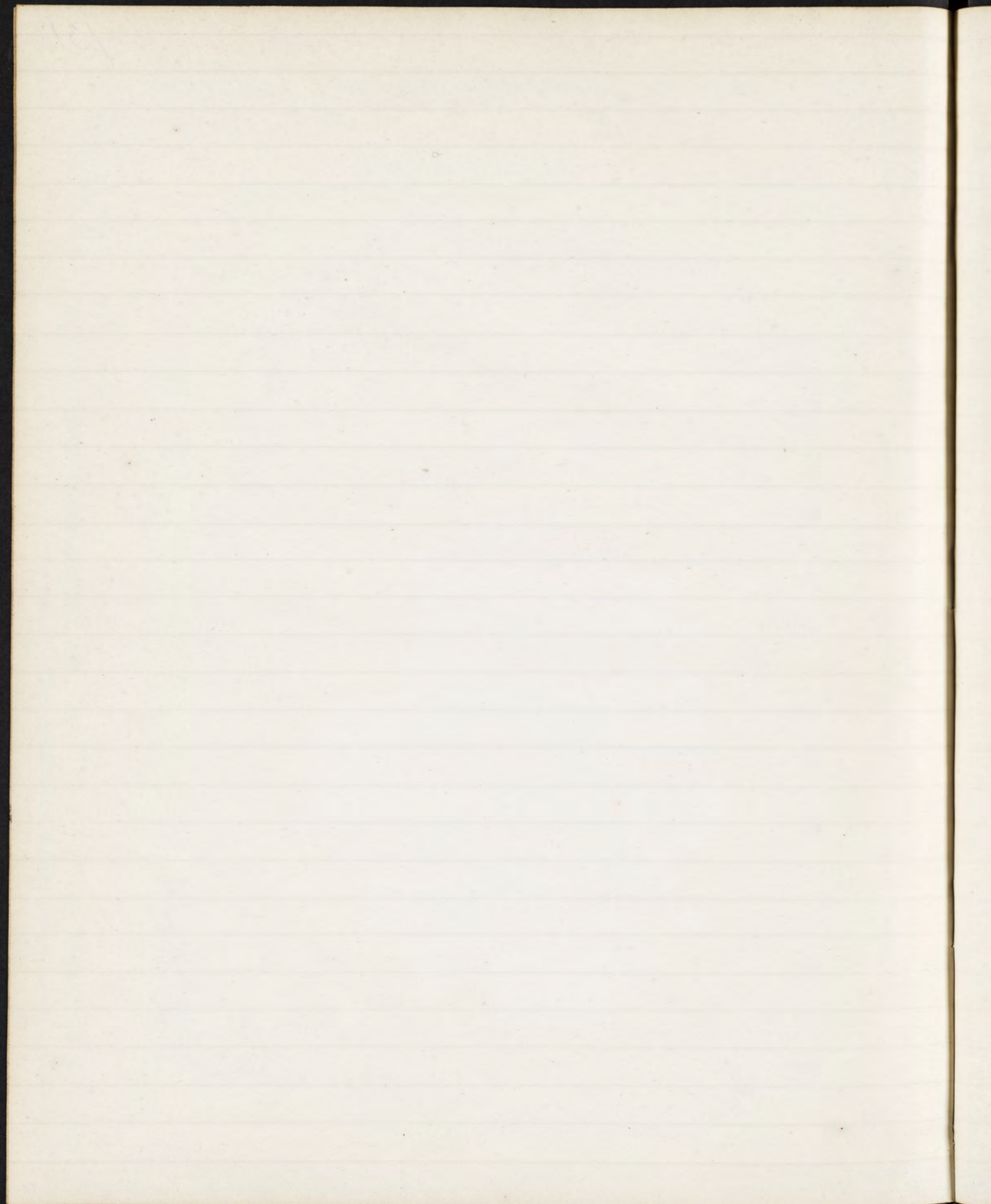


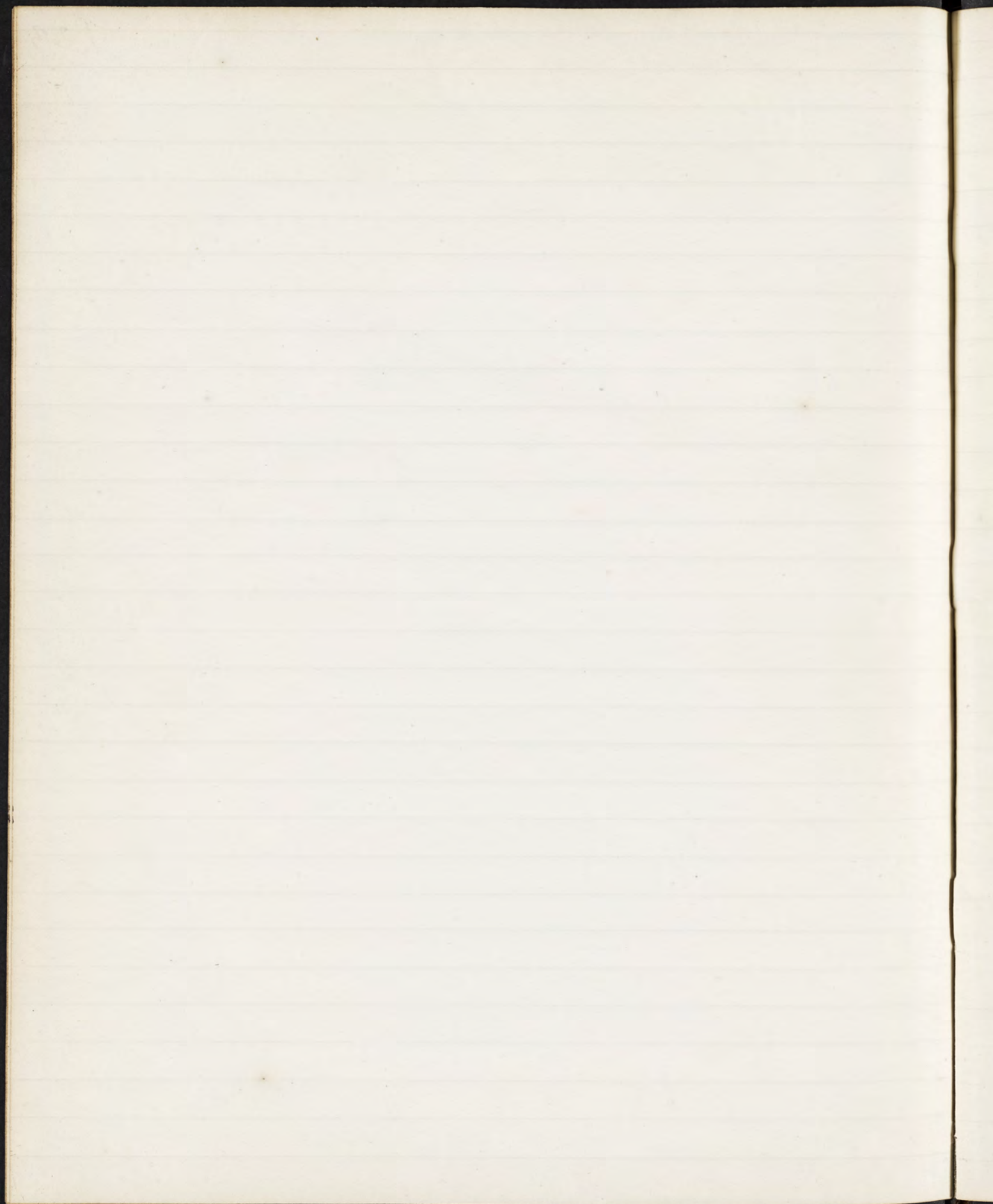


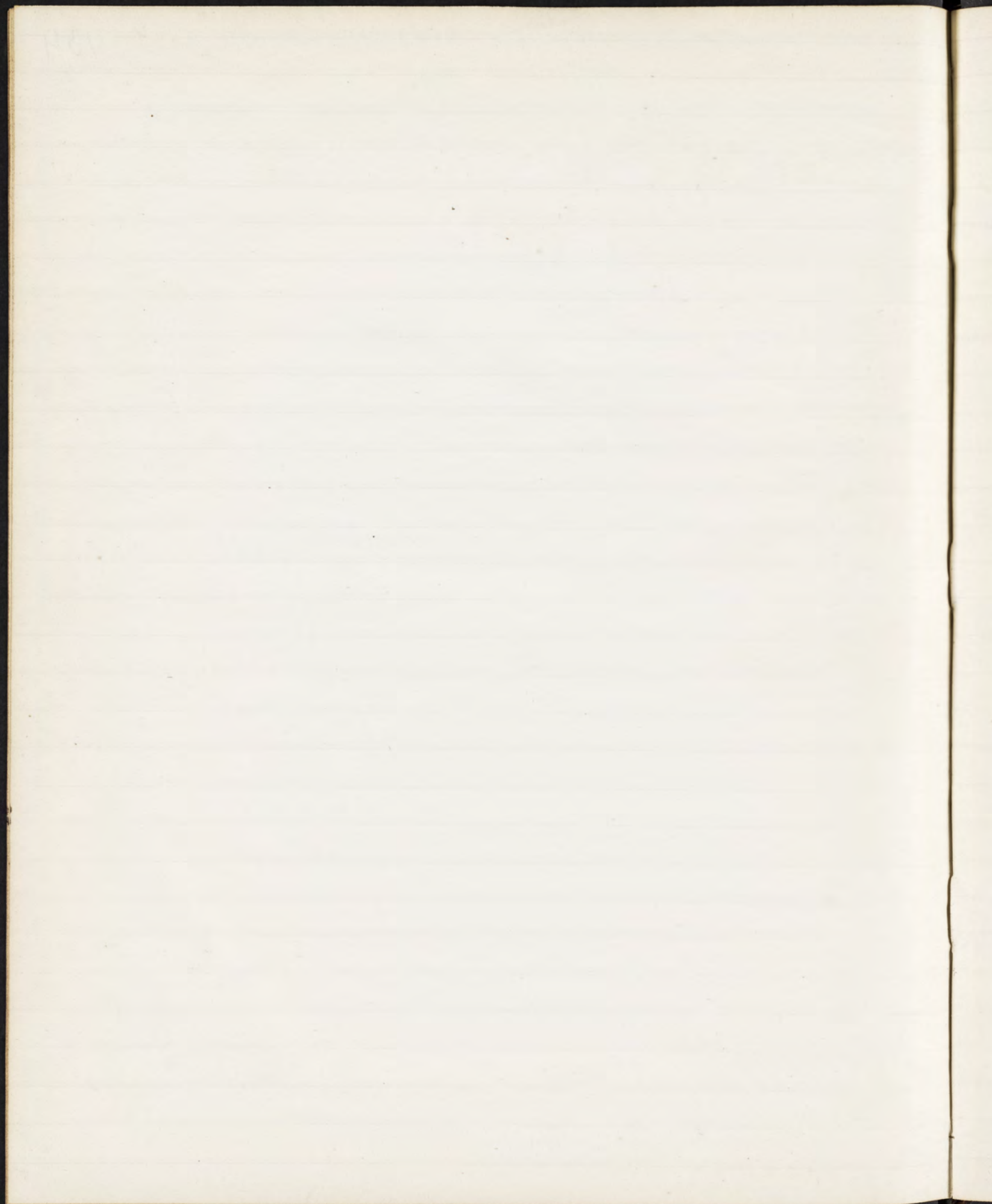


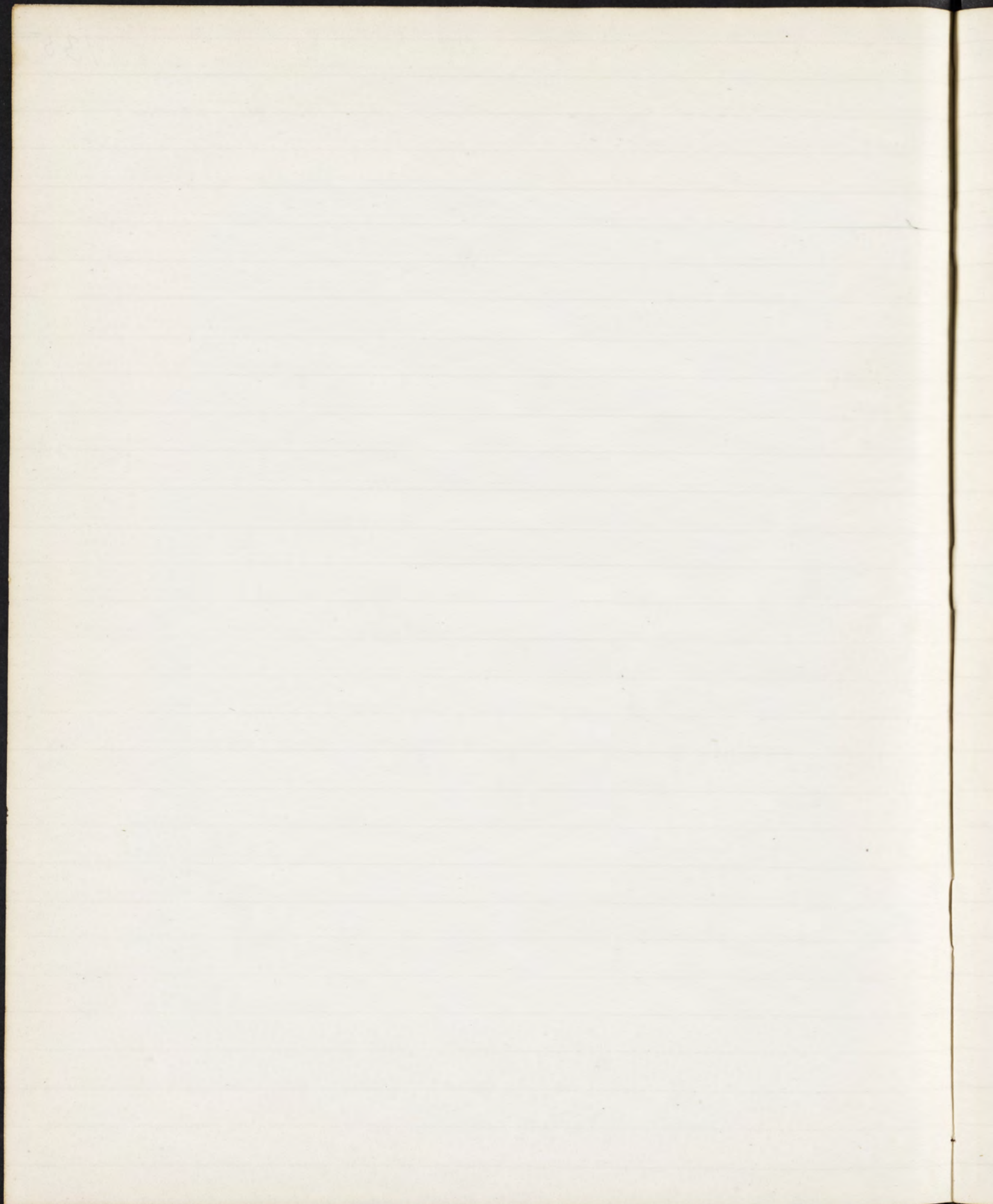


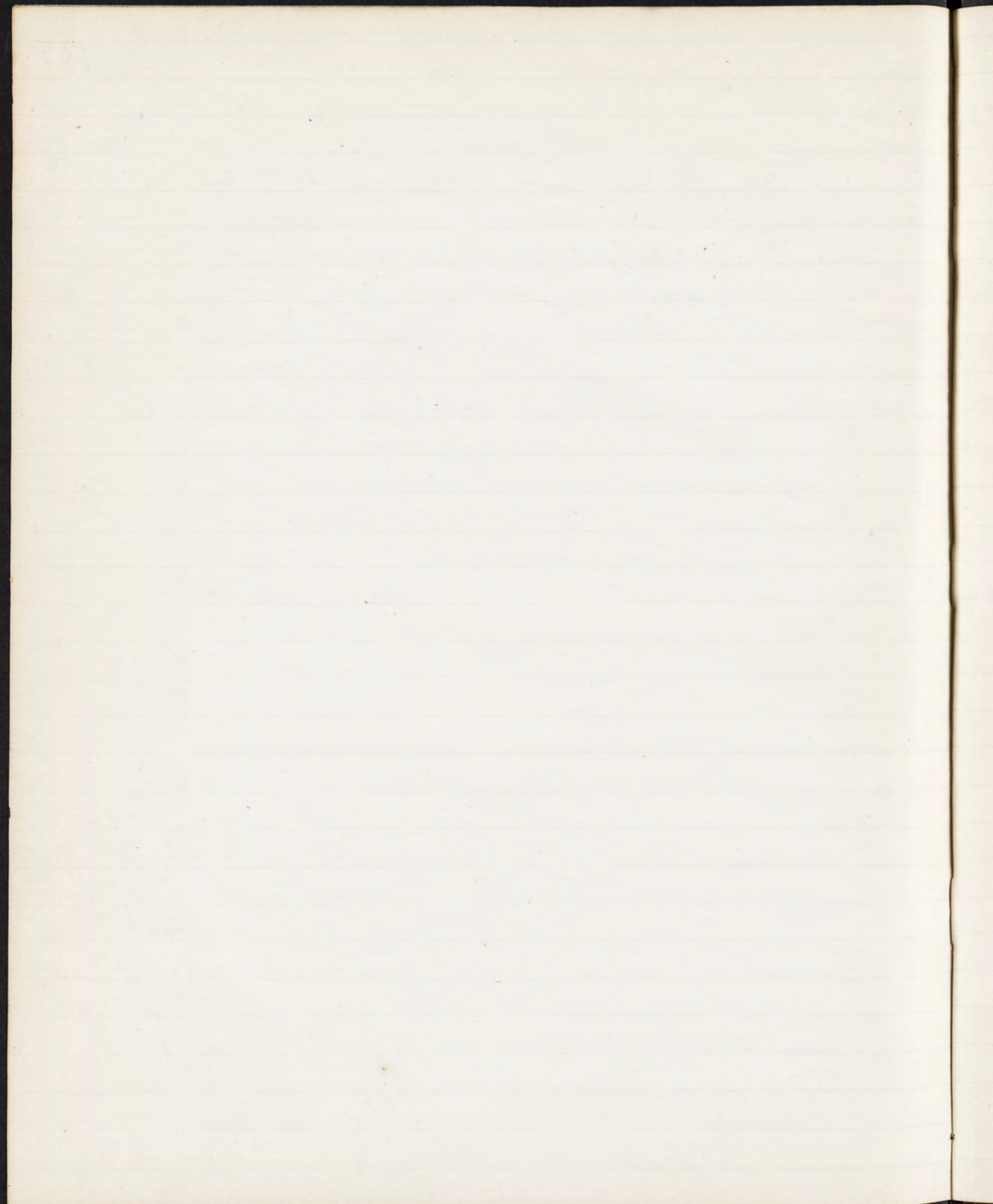


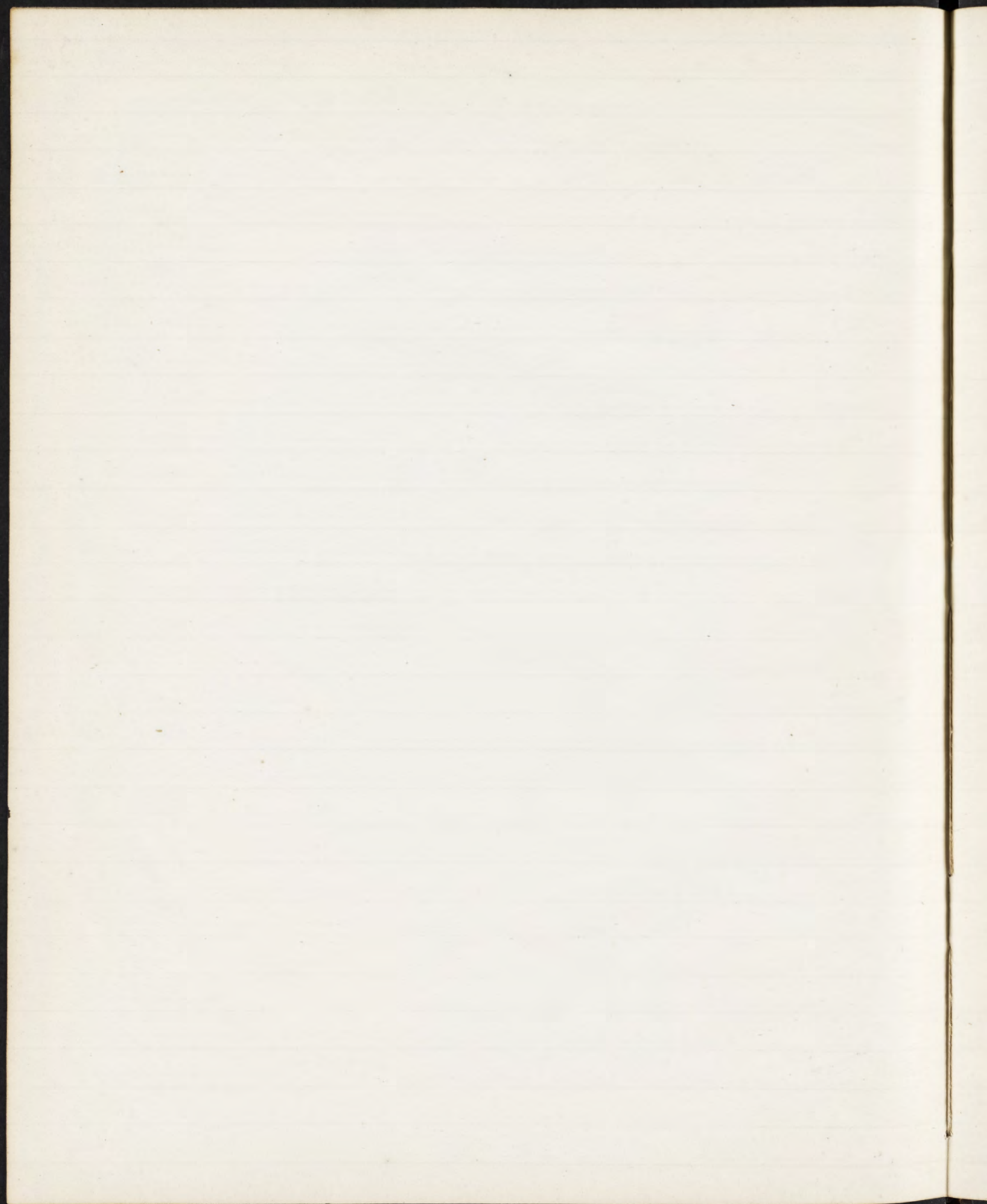


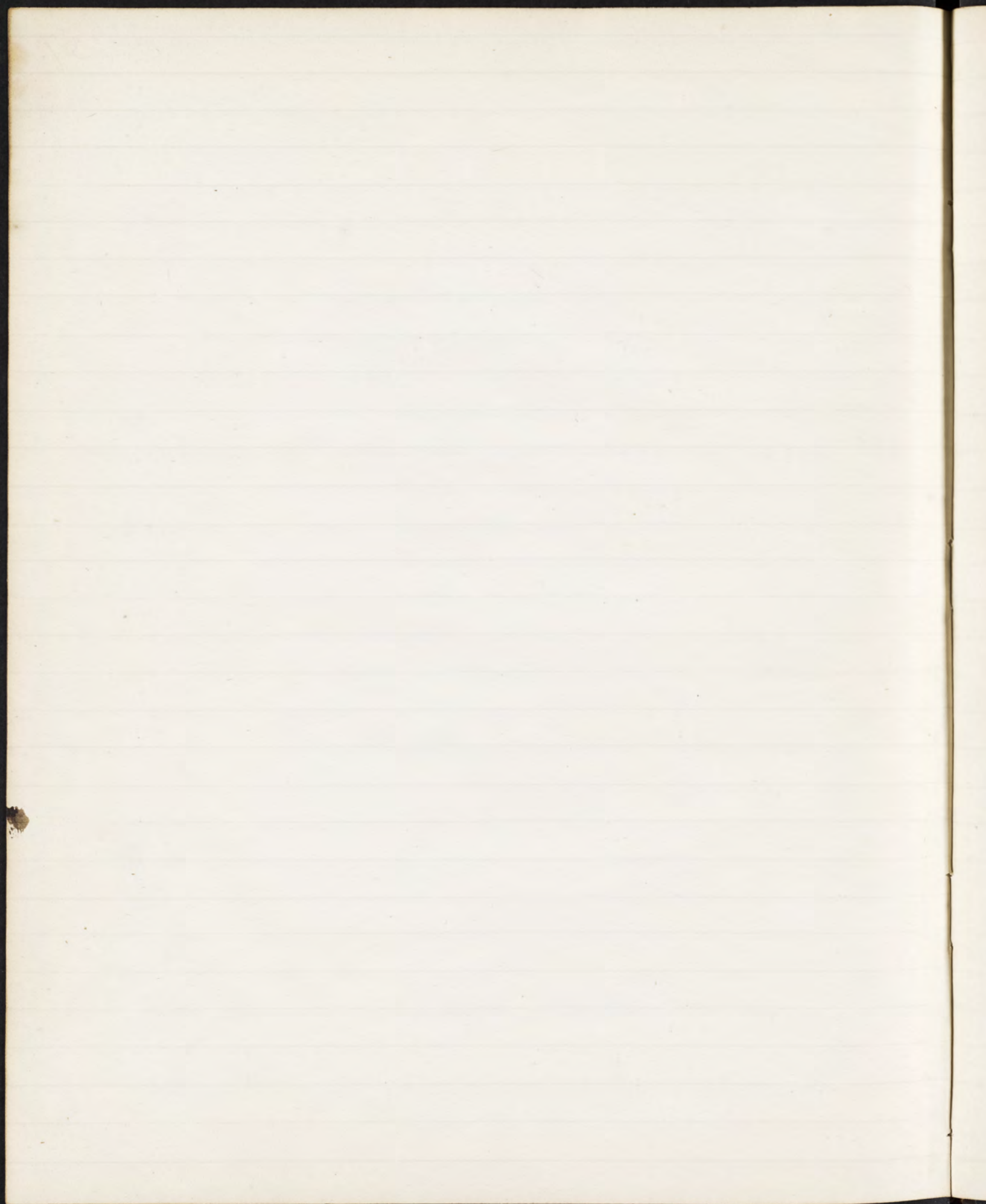




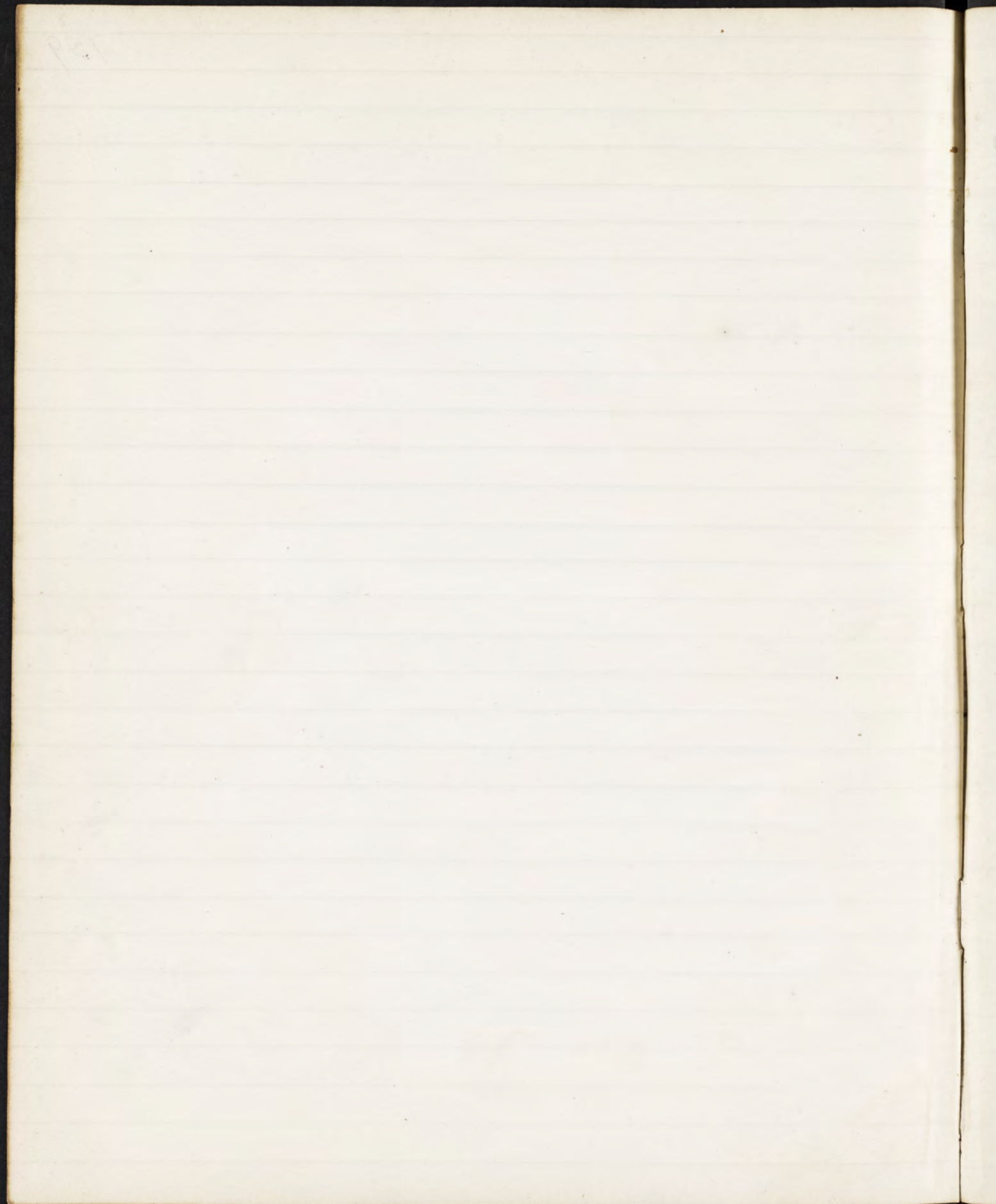








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 440
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Weights - two kinds used -

Avoirdupois & Troy or Apothecaries -

The druggist buys with the one & sells with the other.

Avoirdupois -

$$\begin{array}{rcl}
 1 \text{ lb} & = & 16 \text{ oz} - 256 \text{ } \} = 7000 \text{ gr} \\
 & & 1 & = & 16 & = & 437 \frac{1}{2} \\
 & & " & & 1 & = & 27.34
 \end{array}$$

Troy -

$$\begin{array}{rcl}
 1 \text{ lb} & = & 12 \text{ } \frac{2}{3} & = & 96 \text{ } \frac{2}{3} & = & 288 \text{ } \frac{2}{3} & = & 5760 \text{ gr} \\
 & & 1 & = & 8 & = & 24 & = & 480 \\
 & & & & 1 & = & 3 & = & 60 \\
 & & & & & & 1 & = & 20
 \end{array}$$

Apothecaries measure

$$\begin{array}{rcl}
 1 \text{ gal} & = & 8 \text{ pts} & = & 128 \text{ } \frac{2}{3} & = & 1024 \text{ } \frac{2}{3} & = & 1440 \text{ ml} \\
 & & 1 & = & 16 & = & 128 & = & 1680 \\
 & & & & 1 & = & 80 & = & 480 \\
 & & & & & & 1 & = & 160
 \end{array}$$

The disproportion between Avoirdupois & Troy is $\frac{1}{4}$ - so that in dispensing Medicines there would be considerable ~~difference~~^{error} produced by using them indiscriminately. Great care should be taken to express fluid ounces by measure, otherwise ⁱⁿ the exhibition of articles

of different specific gravities, if weights were taken, more or less would be given than was intended, as for instance, ether which is light, sulphuric acid which is heavy & this is greater if avoirdupois weights be used.

Graduated measures are used, of standard authority & for minims a minim glass.

Difference between minims & drops —

Drops may measure a minim or two may be required.

Their size depends upon the mouth of the bottle from which dropped, or on the density or tenacity of the liquid. A tube with a piston at the end attenuated to a point is sometimes used for drops —

Teaspoons, table & dessert spoon their capacities.

A different opinion is held by the
people, who are not so much
interested, as for instance, the
people of the United States, who
are not so much interested in the
subject.

It is a common opinion that the
people of the United States are
not so much interested in the
subject as the people of the
United States are.

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